DC-300A

crown

SERIAL NO. ________________

ISSUED TO ________________

SERVICE MANUAL
DC-300A
DUAL-CHANNEL
LABORATORY AMPLIFIER

1718 W. MISHAWAKA ROAD, ELKHART, INDIANA 46517

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FIGURE 1-1
MODEL DC-300A, DUAL-CHANNEL LABORATORY AMPLIFIER

1.1 GENERAL

A dual-channel, high-power amplifier for precision amplification of frequencies from DC to 20 KHz, the DC-300A unit features extremely low harmonic and intermodulation distortion, very low noise, highest "damping factor" and quality workmanship and components. A monaural 70-volt balanced line may be obtained without using an output transformer because of the large output power.

The DC-300A contains a new CROWN-developed Signal Programmed Automatic Current Executor (SPACE control) electronic amplifier protection circuit which manifests no flyback pulses, thumps, or shutdown. At audio frequencies any impedance load, including totally reactive loads, may be driven without adverse effects. Only maximum output power is affected by variations in load impedance. At sub-sonic to DC frequencies the limiter acts as a VI limiter to provide optimum protection for the rugged silicon hometaxial output devices (16 for a total of 2400 W dissipation).

Two thermal switches remove power from the unit if overheating occurs due to insufficient ventilation. The AC power line is fused to protect the power supply. Section 3 contains a detailed description of the unit protective systems.

The power supply features a 1 KW transformer and large computer-grade filter capacitors capable of energy storage over 48 joules.

The IC input operational amplifiers are powered by two voltage-regulated supplies, resulting in complete channel-to-channel isolation and independence from line voltage variations.

Total direct coupling results in perfect, instantaneous, thump-free overload recovery even on non-symmetrical waveforms. No AC-coupled amplifier presently in existence gives this performance. Turn-on is instantaneous with no thumps or program delays.

Sixteen output devices (8 per channel), are conservatively used, having a total peak current rating per channel of 120 amperes in a circuit limited to a maximum of 28 amperes. Output circuitry includes among its unique features, the CROWN-pioneered and patented AB+B output configuration.

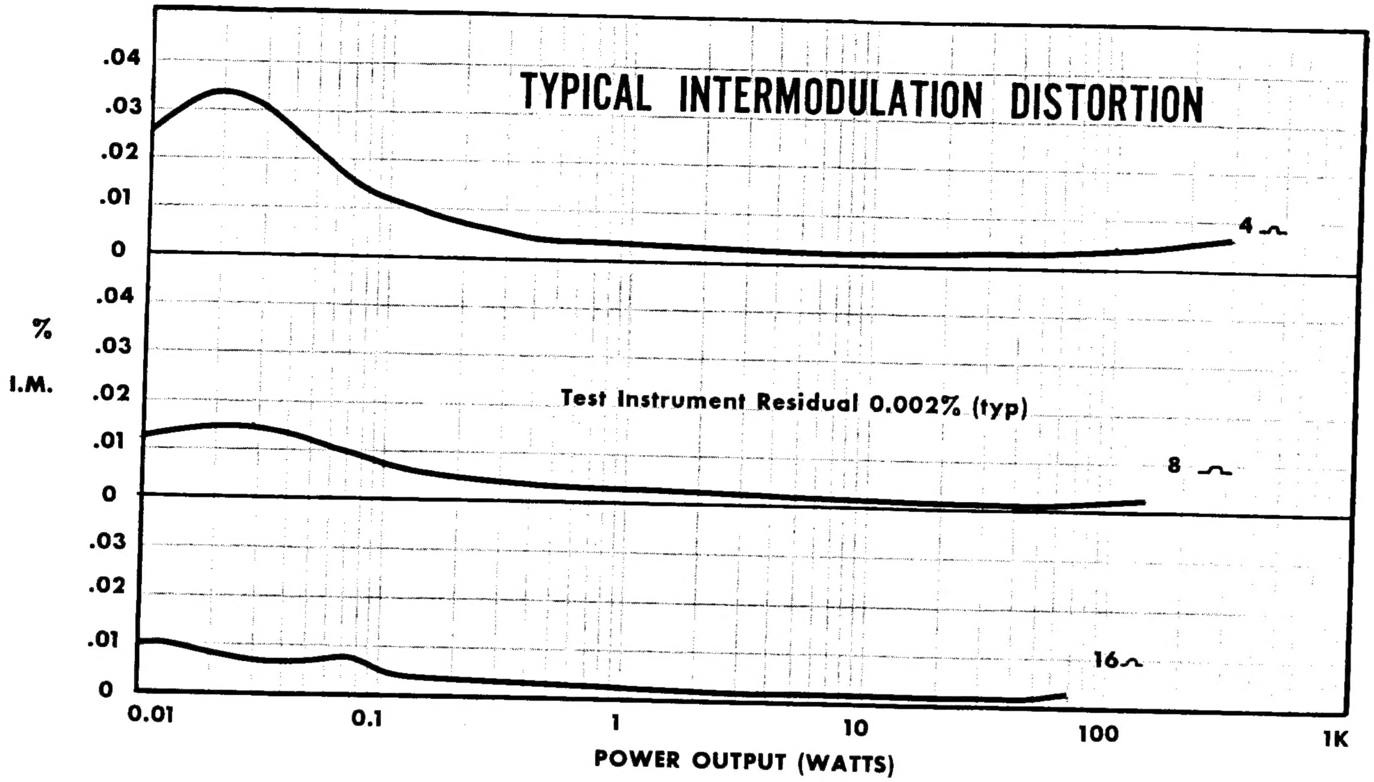
The DC-300A may be housed in an attractive, woodgrain cabinet or mounted in a standard 19" rack (W.E. hole spacing). The brushed-aluminum front panel occupies only 7" vertical rack space and the unit is 9¾" deep (from the mounting surface).

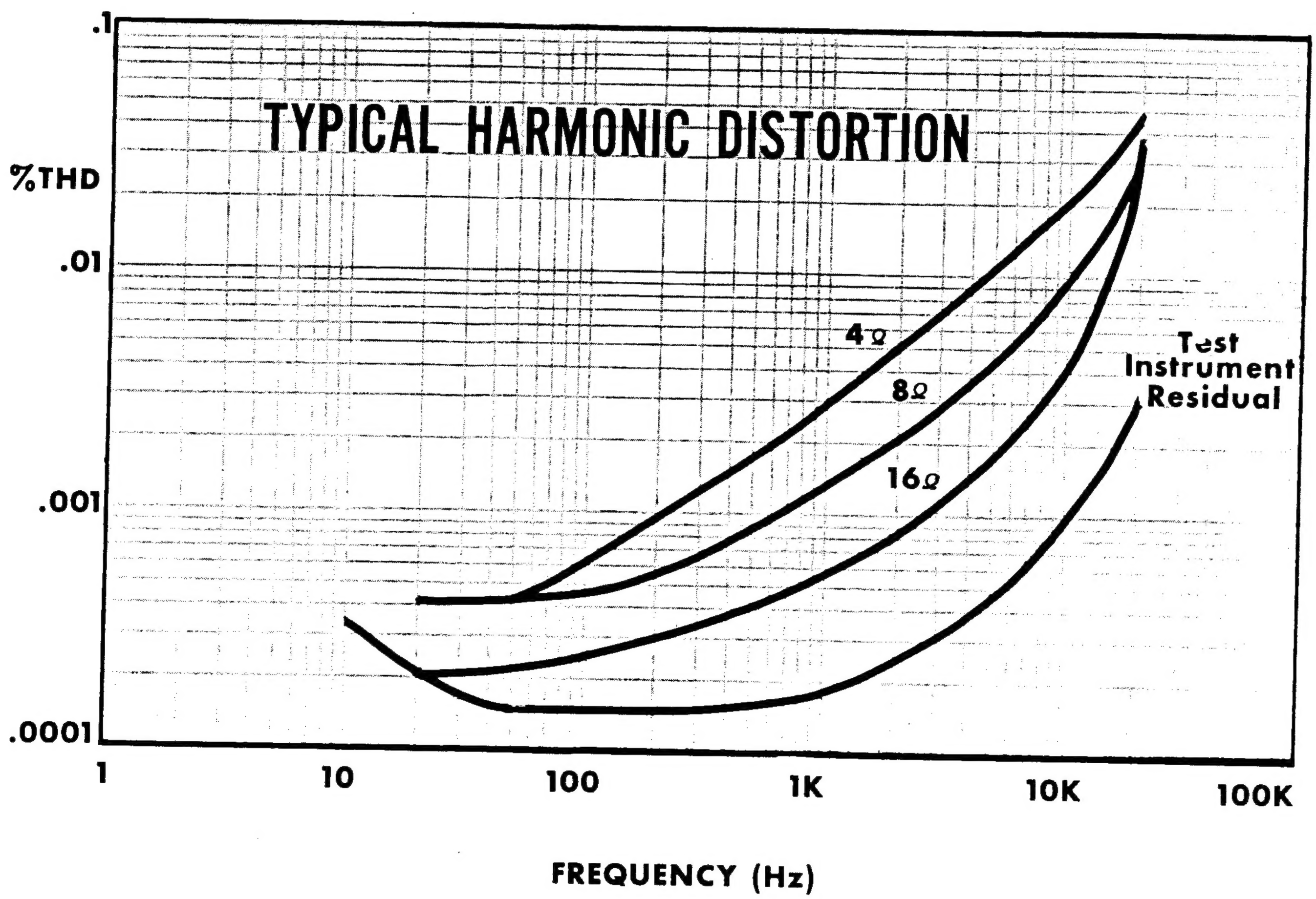
Front panel controls include two independent heavy-duty level controls and a power switch with an associated pilot light. DC balance controls, located behind the front panel, are factory-adjusted and do not need adjustment in normal operation.

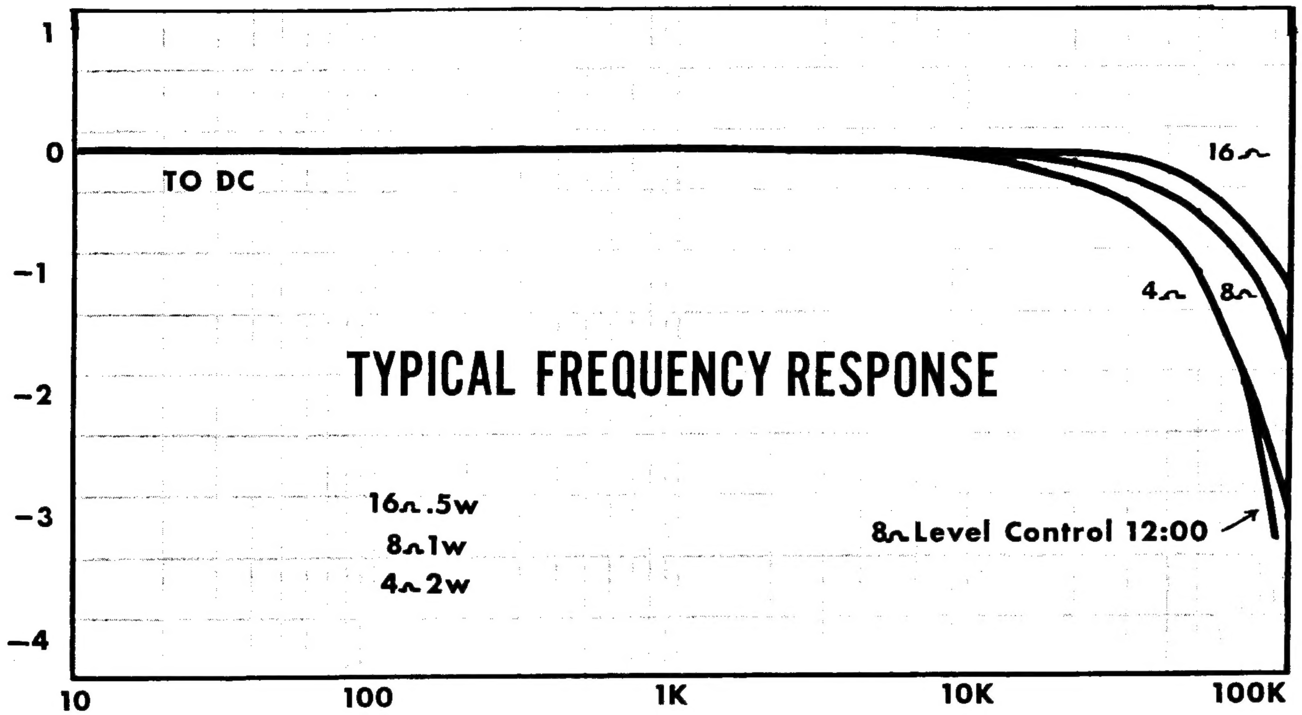
SPECIFICATIONS

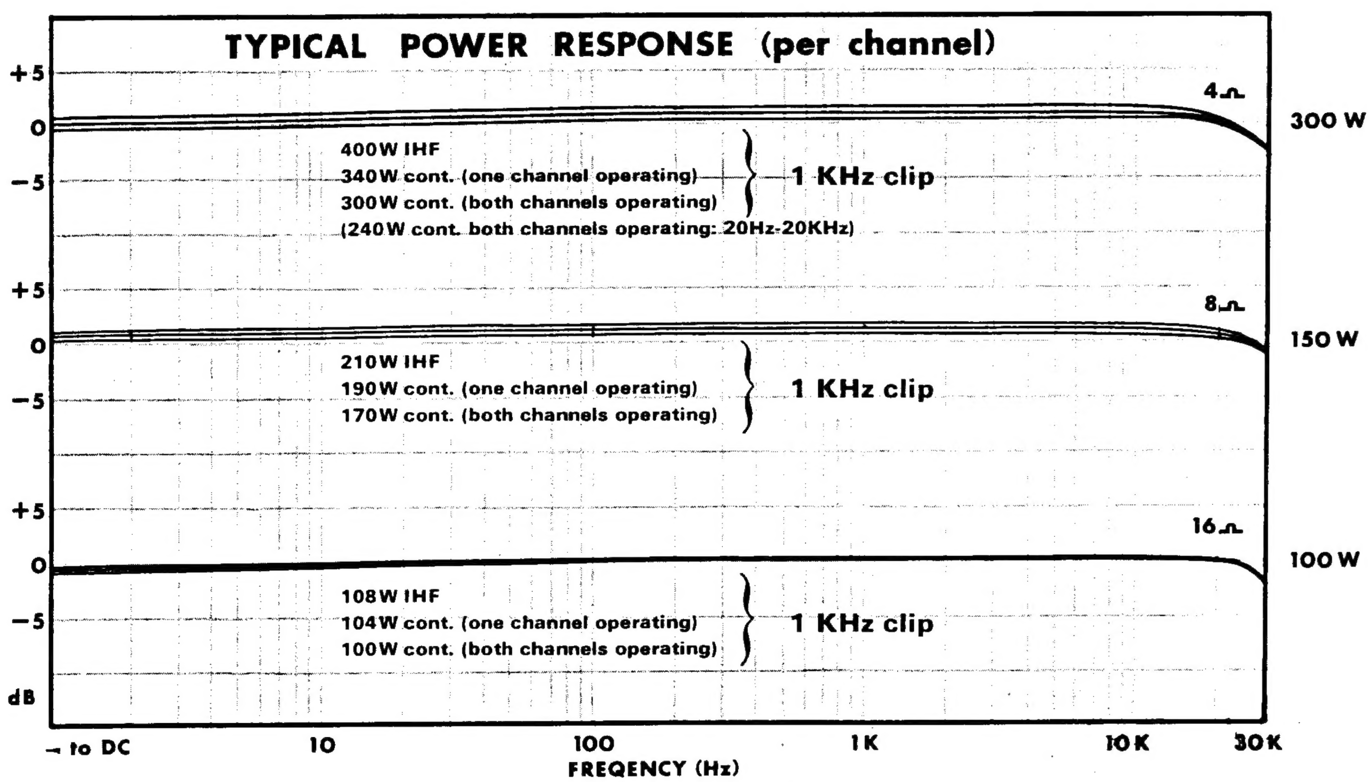
Frequency Response	±0.1db DC -20KHz at 1 watt into 8 ohms, ±1 db Zero - 100KHz (see graphs).
Phase Response	+0, -15° Zero-20KHz, 1 watt into 8 ohms (see graphs).
Power Response	+1 db, -0db DC -20KHz at 150 watts RMS into 8 ohms (see graphs).
Power at Clip Point	Typically 190 watts RMS into 8 ohms, 340 watts RMS into 4 ohms per channel (see graphs).
Total Output (IHF)	Typically 420 watts RMS into 8 ohms, 800 watts RMS into 4 ohms (see graphs).
I.M. Distortion (60-7KHz 4:1)	Less than 0.05% from 0.01 watt to 150 watts RMS into 8 ohms, typically below 0.02%. Less than 0.01% at 150 watts (see graphs).
Damping Factor	Greater than 200 Zero to 1 KHz into 8 ohms (see graph).
Hum and Noise (20-20KHz)	110db below 150 watts RMS output (unweighted, typical 122db).
Slewing Rate	8 volts per micro-second (S-R is the maximum value of the first derivative of the output signal).
Load Impedance	Primarily used at 4 ohms or greater; maximum power at 2.5 ohms, lower impedance affects only maximum power; will drive a completely reactive load with no adverse effects.
Input Sensitivity	1.75 volt ±2% for 150 watts into 8 ohms (see graphs).
Input Impedance	Nominal 100K ohms, 10K ohms at full gain (see graphs).
Output Impedance	See graphs, next pages.
Turn-On	Instantaneous, with no thumps or program delay.
Output Protection	Short, mismatch, and open-circuit proof; protection operates with no flyback pulses, thumps, or shutdown.
Overall Protection	Line voltage is independently fused. Thermal switches in AC line protect against overheating caused by insufficient ventilation. Controlled-slewing-rate voltage amplifiers protect overall amplifier against RF burnouts. Input overload protection is furnished by internal resistance at inputs of amp.
Power Supply	1 KW transformer with heavily-heat-sinked high-current rectifier bridge and massive computer-grade filter capacitors storing over 48 joules of energy. Two regulated supplies for complete isolation and stability.
Power Requirements	Requires 50 to 400Hz AC with adjustable taps for 120, 128, 240, 248, and 256V ±10% operation. Draws 40 watts or less on idle, 500 watts at 300 watts output into 8 ohms per channel.
Heat Sinking	Massive black-anodized heat sinks are thermally joined with chassis, thereby utilizing the entire amplifier as a heat sink.
Chassis	All-aluminum construction for maximum heat conduction and minimum weight. Heavy aluminum front panel is a single extrusion.
Controls	Heavy-duty independent input level controls are on front panel. Power switch, with adjacent pilot light is on front panel. Non-interacting DC balance controls are mounted behind front-panel.
Connectors	Input — ¼ inch phone jack. Output — Color coded binding posts. AC Line — Three-wire (grounded) male connector on 5 ft. min. cable.
Dimensions	19 in. standard rack mount (W.E. hole spacing), 7 in. height, 9¾ in. deep (from mounting surface).
Weight	45 pounds net weight.
Finish	Bright-anodized brushed-aluminum front-panel.

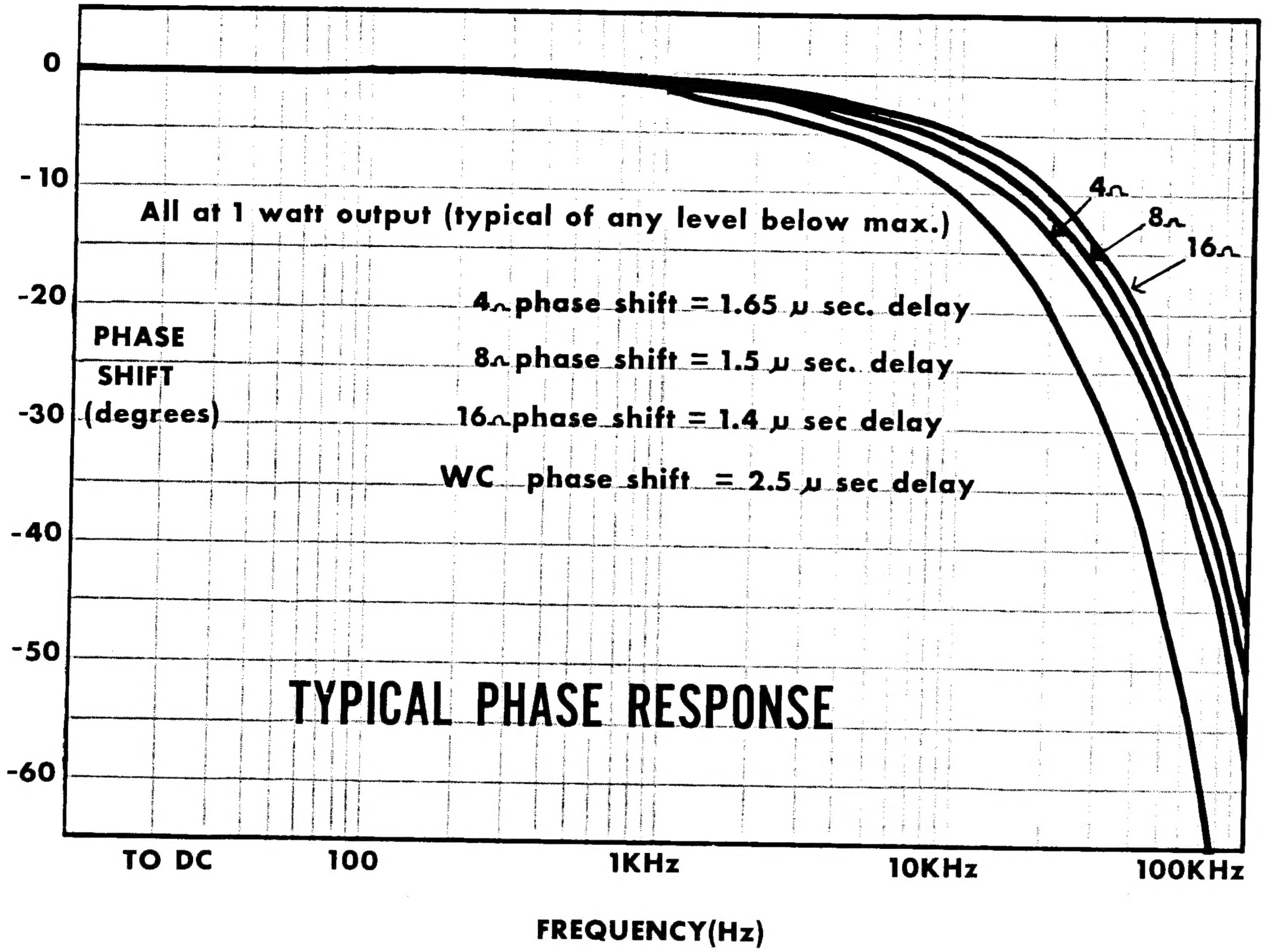
DC 300A PERFORMANCE GRAPHS

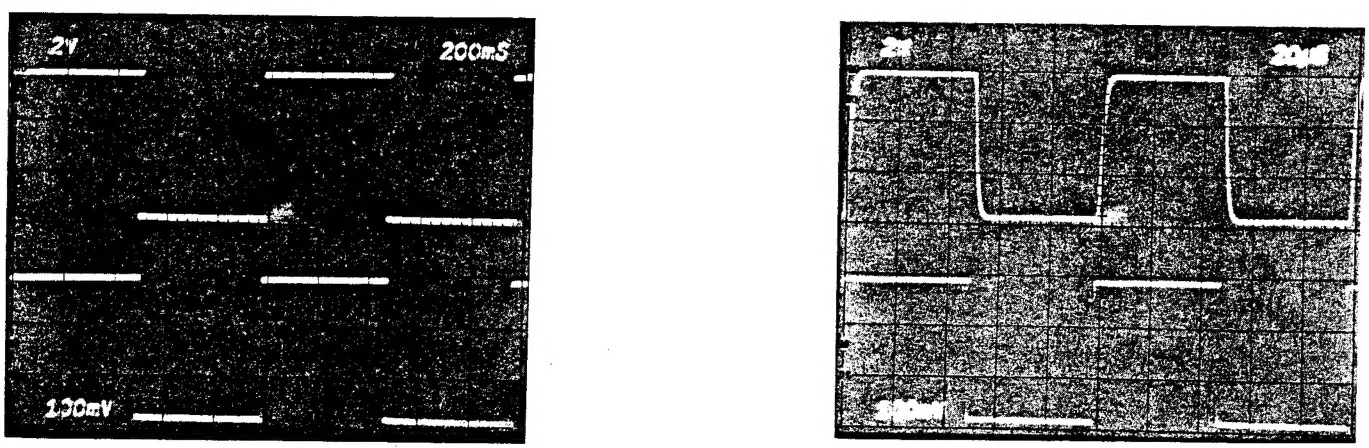




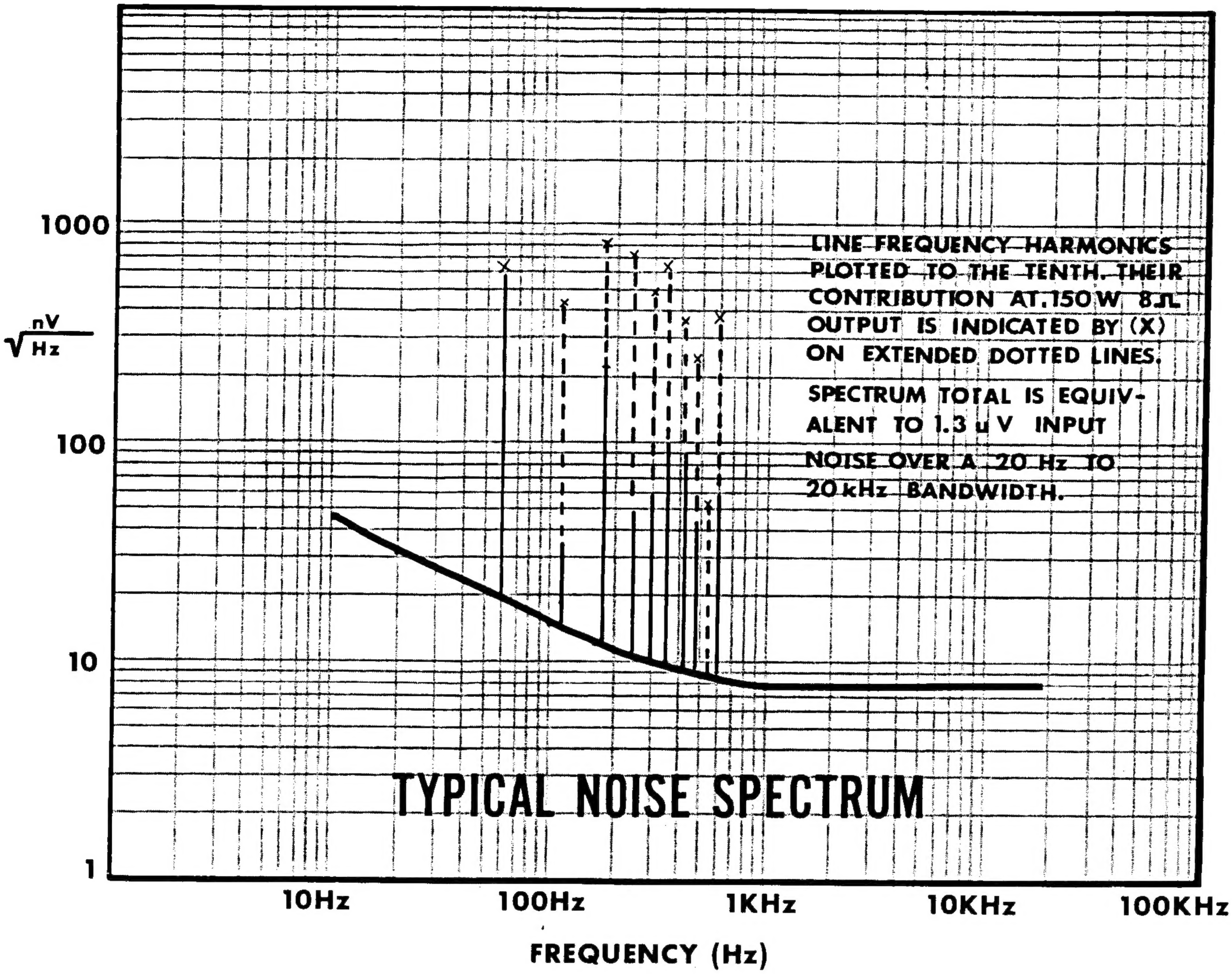

TYPICAL FREQUENCY RESPONSE
1
0
-1
-2
-3
-4
TO DC
16Ω
4Ω
8Ω
16Ω .5w
8Ω 1w
4Ω 2w
8Ω Level Control 12:00
10
100
1K
10K
100K

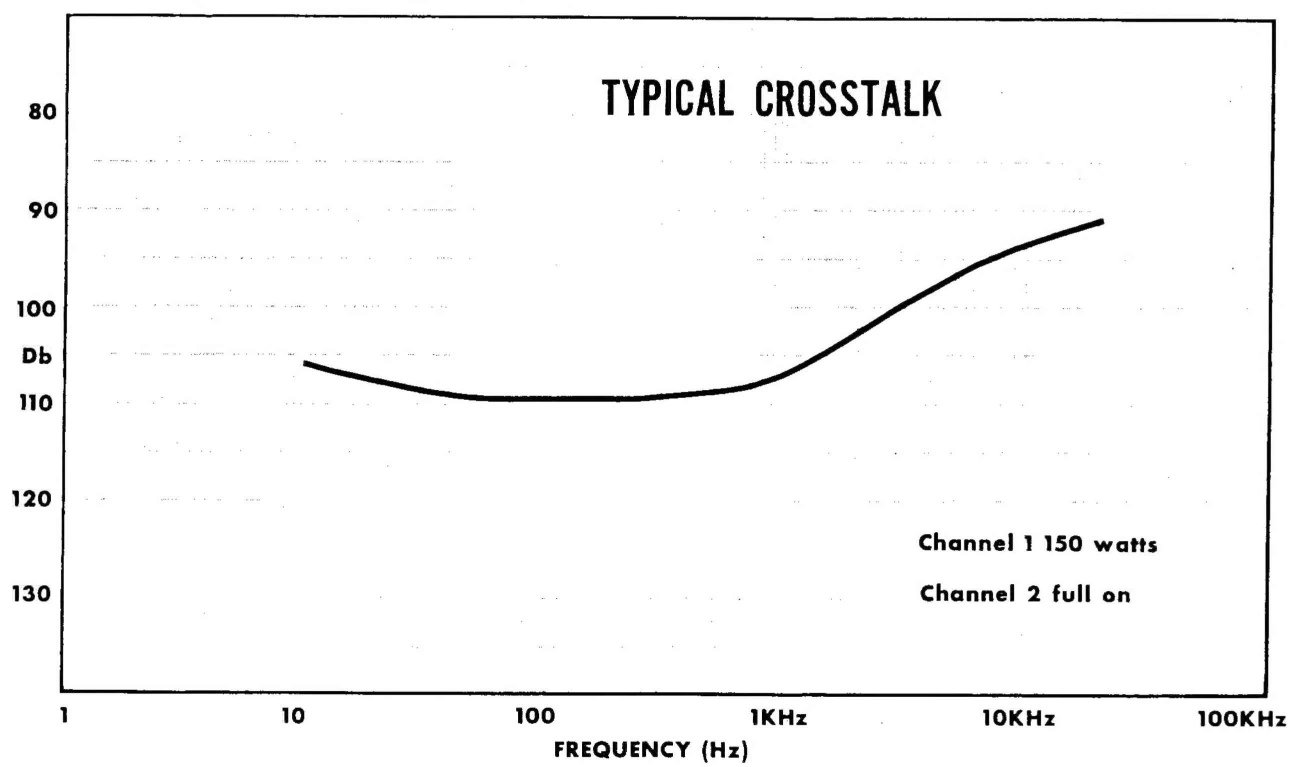

TYPICAL POWER RESPONSE (per channel)
+5
0
-5
4Ω
300 W
400W IHF
340W cont. (one channel operating)
300W cont. (both channels operating)
1 KHz clip
(240W cont. both channels operating: 20Hz-20KHz)
8Ω
150 W
210W IHF
190W cont. (one channel operating)
170W cont. (both channels operating)
1 KHz clip
16Ω
100 W
108W IHF
104W cont. (one channel operating)
100W cont. (both channels operating)
1 KHz clip
dB
→ to DC
10
100
1K
10K
30K
FREQENCY (Hz)



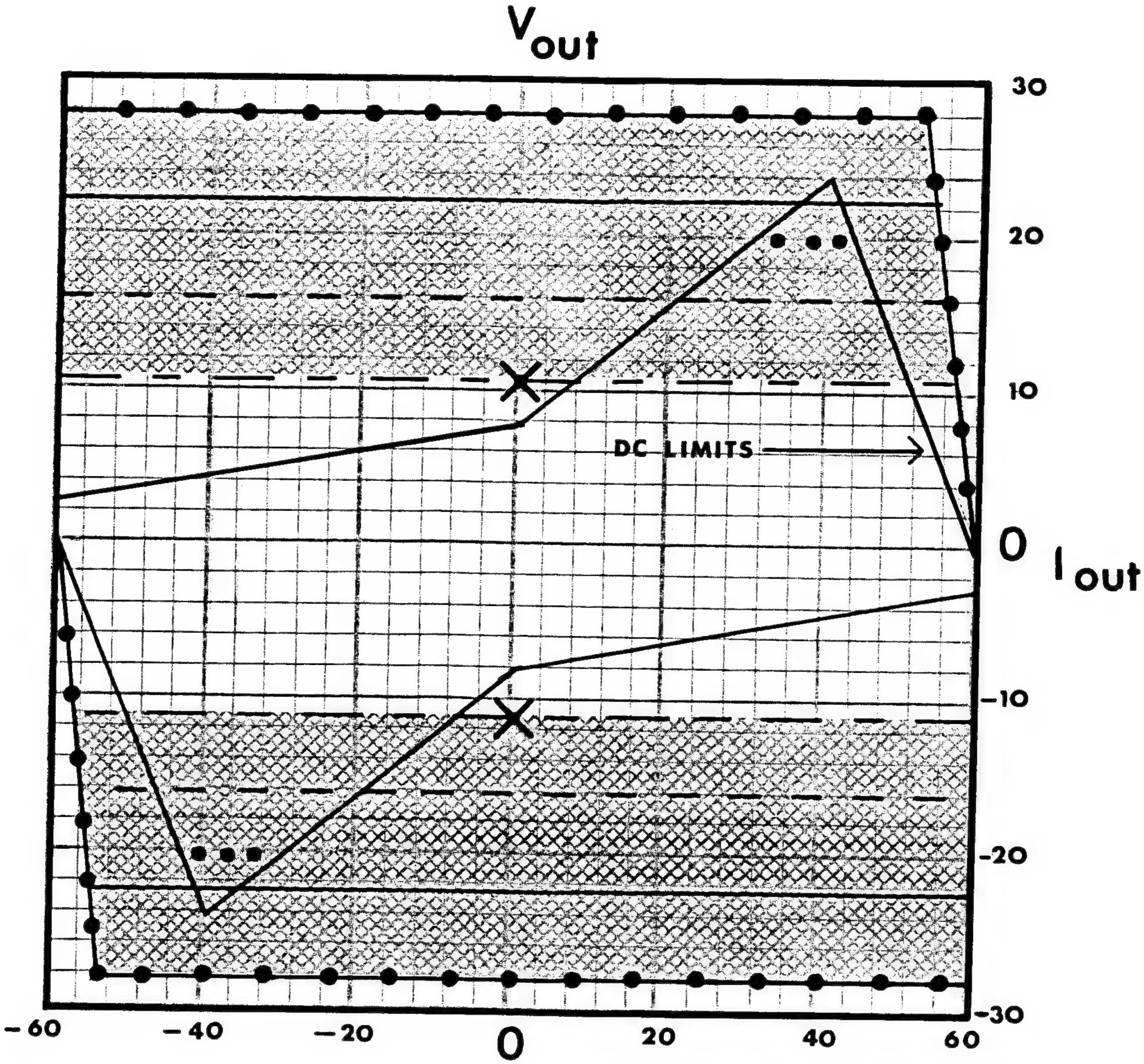


1 Hz **SQUARE WAVE RESPONSE** 10 KHz


TYPICAL NOISE SPECTRUM
LINE FREQUENCY HARMONICS PLOTTED TO THE TENTH. THEIR CONTRIBUTION AT 150 W 8Ω OUTPUT IS INDICATED BY (X) ON EXTENDED DOTTED LINES.
SPECTRUM TOTAL IS EQUIVALENT TO 1.3 u V INPUT NOISE OVER A 20 Hz TO 20 kHz BANDWIDTH.
1000
100
10
1
nV/√Hz
10Hz
100Hz
1KHz
10KHz
100KHz
FREQUENCY (Hz)


TYPICAL CROSSTALK
80
90
100
Db
110
120
130
Channel 1 150 watts
Channel 2 full on
1
10
100
1KHz
10KHz
100KHz
FREQUENCY (Hz)

TYPICAL LIMITS OF VI OUTPUT



● ● ● AC LINE FUSE BLOWS (DC SINGLE CHAN.) BLOWS AT 10A DC IF BOTH CHANNELS ARE DRIVEN EQUALLY

— — MID-FREQUENCY BURST LIMIT

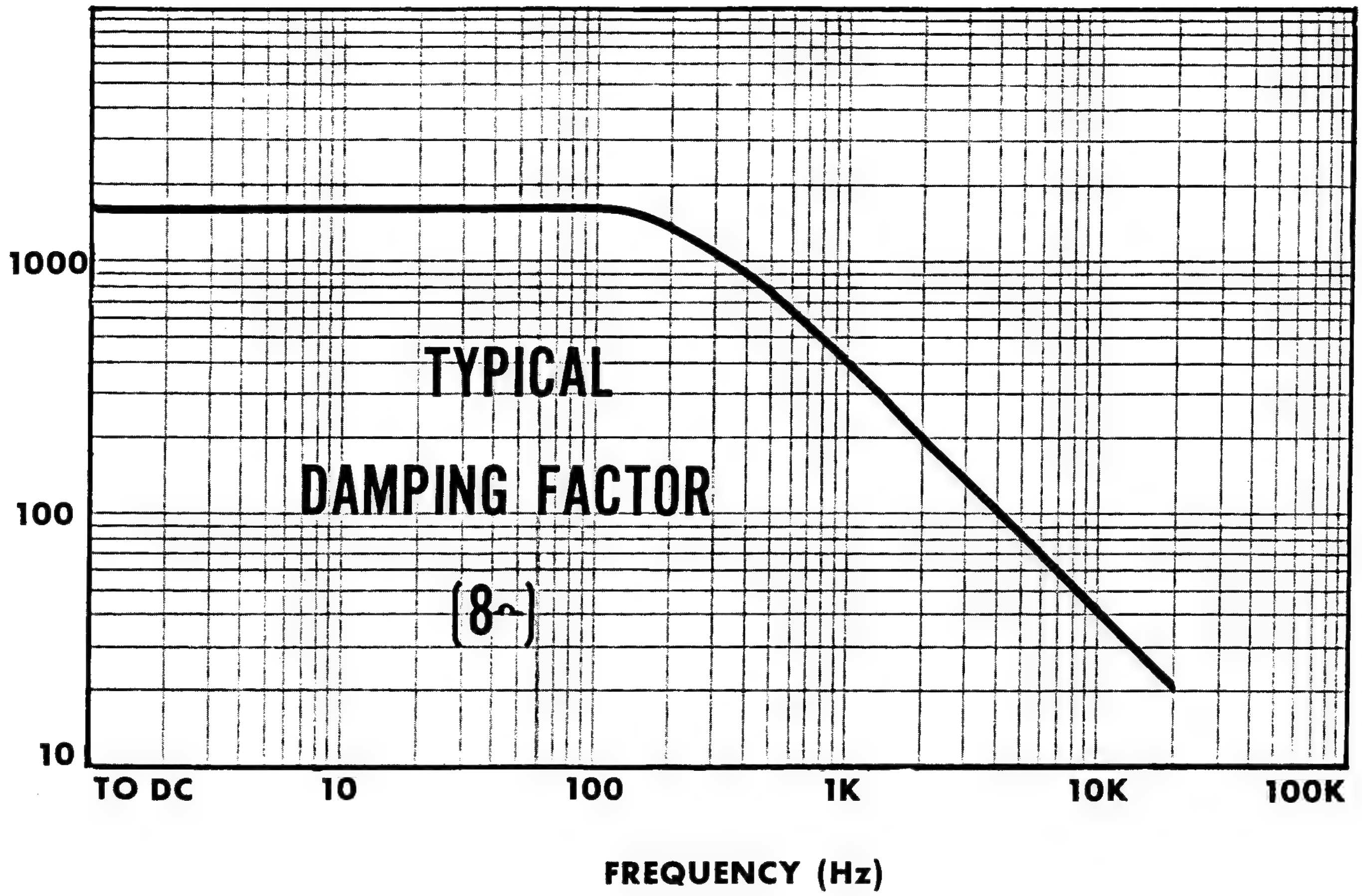
X SHORT CIRCUIT CONTINUOUS LIMIT

AREA OVER WHICH LIMITER (AC) VARIES (SIGNAL DEPENDENT)

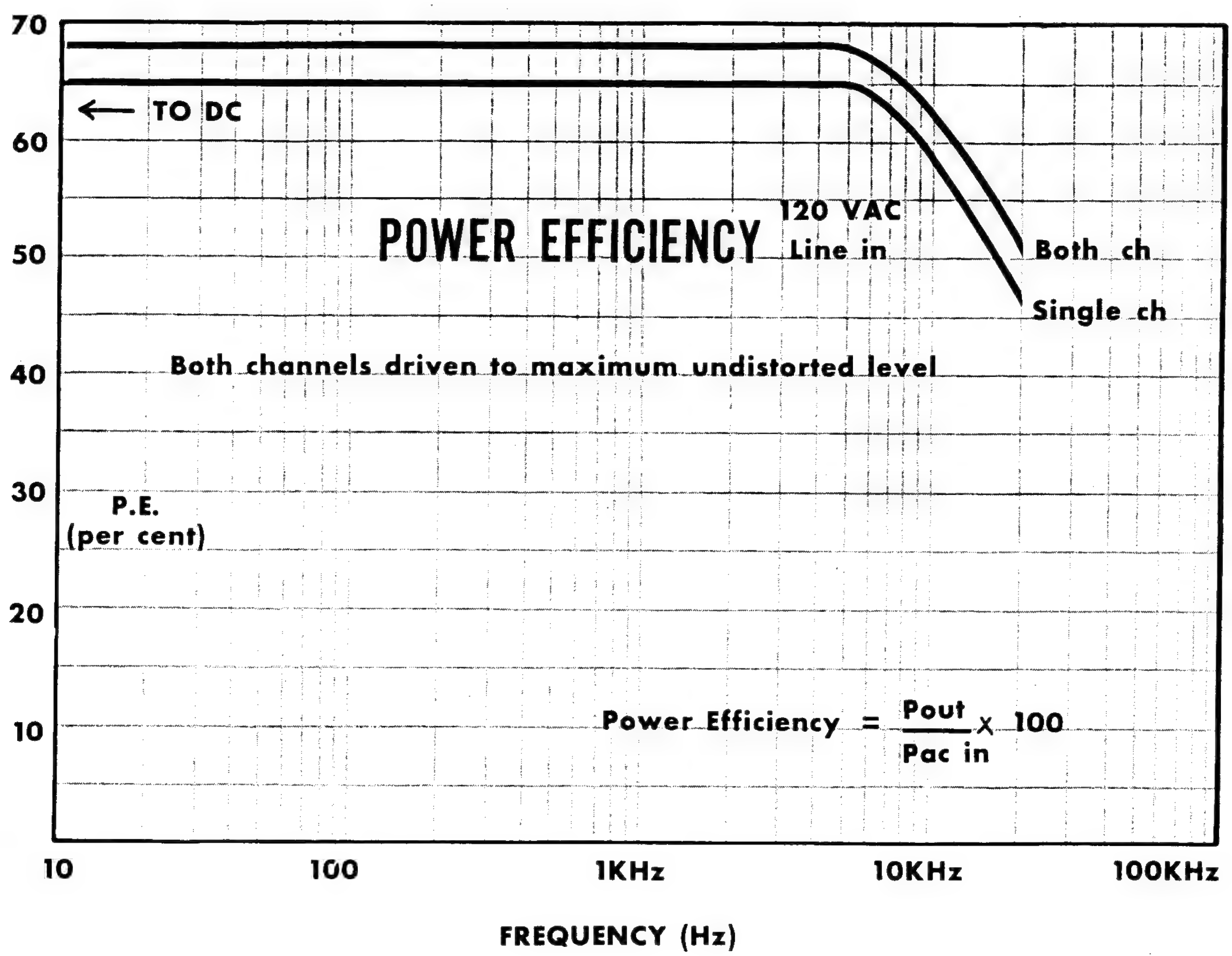
●—●—● MAX. AC LIMIT (Z_L, V OUT (SINE) AT MAX.)

—— MAX. CONT. AC POWER (Z_A = 2.75Ω)

——— — HIGH FREQUENCY LIMIT



TYPICAL
DAMPING FACTOR
(8Ω)
1000
100
10
TO DC
10
100
1K
10K
100K
FREQUENCY (Hz)



70
60
50
40
30
20
10
← TO DC
POWER EFFICIENCY
120 VAC
Line in
Both ch
Single ch
Both channels driven to maximum undistorted level
P.E.
(per cent)
Power Efficiency = Pout / Pac in x 100
10
100
1KHz
10KHz
100KHz
FREQUENCY (Hz)

3.1 SCOPE

This section contains installation and operation instructions for the DC-300A amplifier. Also included are descriptions of the protective mechanisms for the amplifier and the load together with a list of operating precautions to help clarify proper operating procedures.

3.2 UNPACKING

Immediately upon receipt of the amplifier shipment, inspect the unit for any damage incurred in transit. The amplifier was carefully inspected and tested and left the factory unmarred. Notify the transportation company immediately if any damage is found. Only the consignee may initiate a claim with the carrier for damage during shipment. However, CROWN will cooperate fully in such an event. Be sure to save the carton as evidence of damage for the shipper's inspection.

CROWN recommends that you save the packing materials, even if the unit arrives in perfect condition. They will prove valuable in preventing damage should there be occasion to transport or ship the unit. Both the carton and internal pack are specifically designed for protection during transit, particularly of the power transformer weighing over 25 pounds. **Do not ship the unit without this factory pack!**

Be sure to return the warranty registration form to the CROWN factory within ten days for the full warranty coverage.

3.3 MOUNTING

The DC-300A amplifier is specifically designed for standard 19" rack mounting, but may be custom mounted if sufficient support is provided. See Figure 3-1 for mounting dimensions. Sufficient ventilation should always be provided for the unit. Good ventilation practice allows air to flow completely under, around and through the amplifier. If the unit is placed above a horizontal surface, an air space should be allowed above and below the unit. If sufficient ventilation is not provided, the unit will intermittently turn off due to the built-in thermal protection. Such a condition (if observed) will also be accompanied by a warm front panel due to the integral heat-sinking employed in the amplifier.

Applications requiring long sustained signals at high power levels may require the use of a cooling fan.

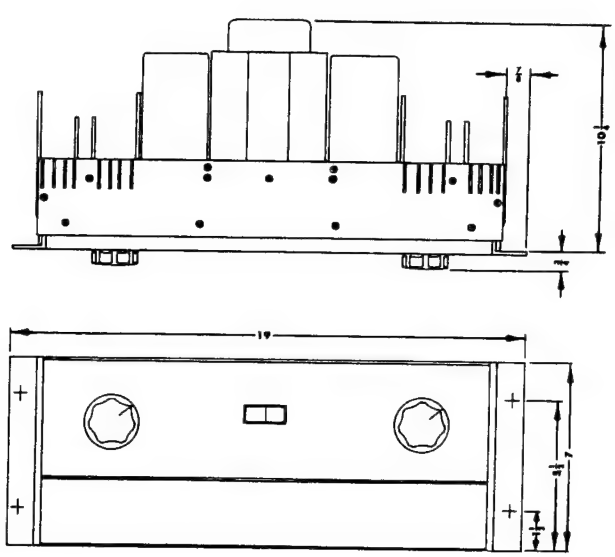


FIGURE 3-1
MOUNTING DIMENSIONS

3.4 AMPLIFIER PROTECTION MECHANISMS

The DC-300A is protected against all the common hazards which plague highpower amplifiers, including shorted, open, and mismatched loads; overloaded power supplies; excessive temperature; chain destruction phenomena; input overload damage; and high frequency overload blowups.

Protection against shorted and low impedance loads is provided by the Signal Programmed Automatic Current Executor (SPACE control). It functions as an automatic current limiter at audio frequencies whose value of current limiting threshold is dependent on the history of the output signal. Output current causes the threshold to decrease while output voltage causes the threshold to increase. The no signal threshold is high enough to allow tone bursting, (even into 4 Ω) without premature limiting as is found in some recent products of other manufacturers.

Since the limiter has no instantaneous response to output voltage, flyback transients do not appear in the output when limiting occurs on inductive loads. Flyback transients are a necessary response of a VI limiter (sometimes misnomered an "Energy Limiter") when limiting drive to an inductive load. The actual response of the flyback pulse is that the amplifier yields to the load resulting in a pulse emanating from the load which returns the inductive energy of the load to the opposite polarity power supply of the amplifier as that supply that produced the excessive output. The audible effect of flyback pulses is to produce a rasping, popping sort of sound which is not pleasing.

A current limiter will not yield to the load but will sustain the constant current demands of the inductive load without flyback.

Early amplifier designs frequently employed fixed current limiters but had serious difficulty with obtaining reliable low frequency output while being capable of full-voltage 4 ohm output. Also, many earlier designs used fragile epi-base or triple diffused outputs, which for reliable performance are poor mates for a current limiter protection scheme. The DC-300A uses eight 150W hometaxial* silicon power transistors per channel, which are the toughest type of audio power transistor yet developed. Their toughness allows the reliable use of a current limiter which when rendered signal variable permits larger power outputs than would be safely allowable with a current limiter of fixed type.

At subsonic frequencies, the SPACE control behaves as a VI limiter and provides the increased protection needed at DC to prevent destruction due to heat buildup in the half of the output stage that is being driven.

The fuse inherently protects the power supplies against overload. The AC line for 120, 128VAC is fused with a 10A 250V type AB fuse (on 240, 248VAC, 5A type 3AG 250V).

The use of any other size fuse will invalidate the warranty.

Never change fuses with power applied!

On each heat sink (see Fig. 3-14) is mounted a thermal switch which protects the amplifier against insufficient ventilation. If either heat sink becomes too hot, the AC line power will be interrupted until the temperature falls to a safe level, whereupon power will be automatically restored. When such an event occurs, the external symptoms are: no indication of AC power (by the pilot), and a warm front panel.

All of the amplifier's voltage-amplifier circuitry is designed to be inherently current-limited. Thereby, if any of the devices should fail, (which is extremely unlikely), no damage will occur to the rest of the stages.

The input stage is protected against overdrive damage by a series limiting resistor should the input signal level ever become very excessive.

The amplifier features a controlled slewing-rate which, coupled with the SPACE controller, protects the amplifier from blowups when fed large RF input signals.

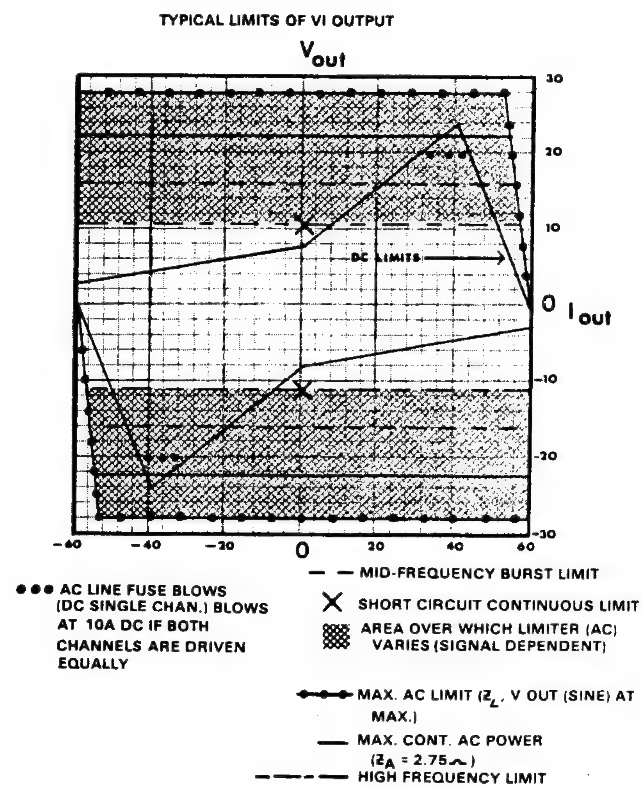


FIGURE 3-2
GRAPH OF VI OPERATING RANGE OF DC-300A OUTPUT

3.5 LOAD PROTECTION METHODS

The most common of all load protection schemes is a fuse in series with the load. The fuse may be single, fusing the overall system. Or, in the case of a multi-way speaker system, it may be multiple with one fuse on each speaker.

*Tradename of RCA

Fuses help to prevent damage due to prolonged overload, but provide essentially no protection against damage that may be done by large transients and such. To minimize this problem, high-speed instrument fuses such as Littlefuse 361000 series are most appropriate for such applications. For a nomograph showing fuse size vs. loudspeaker ratings refer to Fig. 3-3.

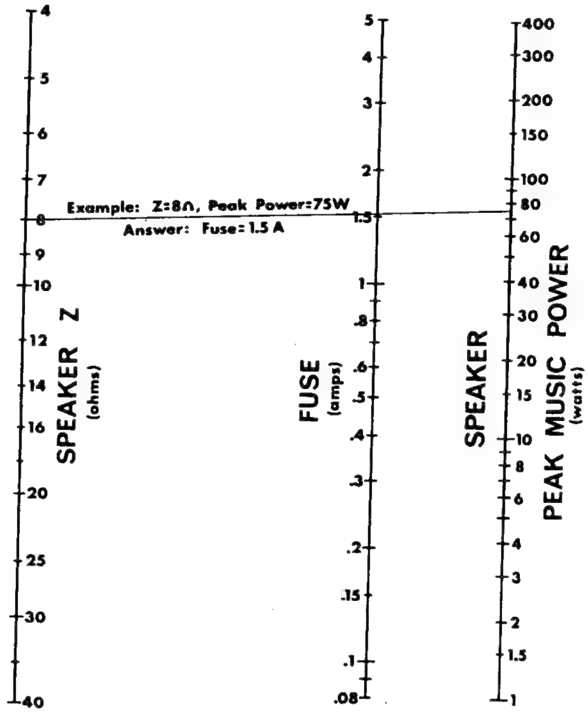


FIGURE 3-3
FUSE SELECTOR NOMOGRAPH FOR LOUDSPEAKER PROTECTION

Another form of load protector is shown schematically in Fig. 3-4. Whenever the load is overdriven, a relay switches a lamp in series with the load, smoothly relieving the overload. The lamp then doubles as an overdrive indicator as it glows. If overdrive is unreasonably severe, the lamp will serve as a fuse. By adjusting the relay tension adjustment and the protection level control, this system is useful from 25 to 200 watts for a typical 8 ohm load.

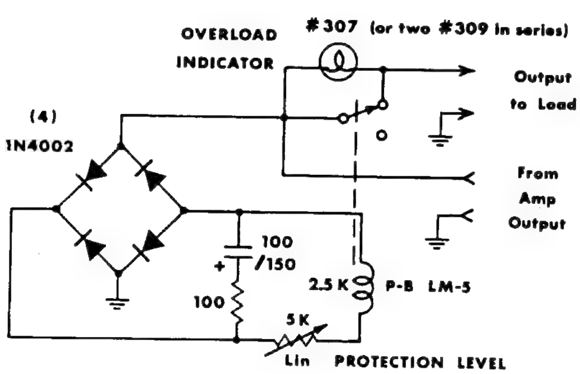


FIGURE 3-4
RELAY CONTROLLED PROTECTOR WITH OVERLOAD INDICATOR

Another more sophisticated form of overload protector relieves the overload by controlling the amplifier's input signal which is creating the overload. This form of protector not only saves the load but also eliminates amplifier overload. With this device, it is possible to operate the amplifier at its maximum level with a minimum of clipping. This device is shown schematically in Fig. 3-5. It features an overdrive indicator, distortionless photo-optical control, and a Protection Level control giving adjustment from 1W to 200W when driving 8 ohms.

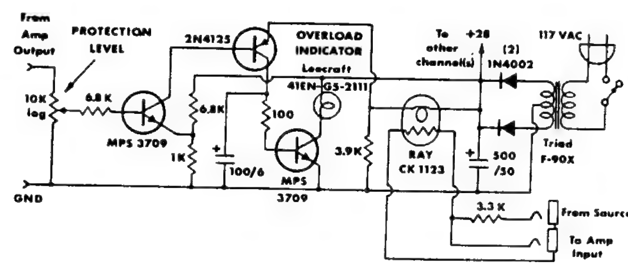


FIGURE 3-5
PEAK POWER LIMITING COMPRESSOR WITH OVERDRIVE INDICATOR

A common problem which causes damage and irritation is the turn-on thump problem typical to many signal sources. Fig. 3-6 shows the schematic of a muter which, when inserted in the input signal line, mutes for several seconds before connecting the source to the amplifier, thereby eliminating turn-on transients. It also removes turn-off transients occurring after the relay drops open (≈0.1 sec.).

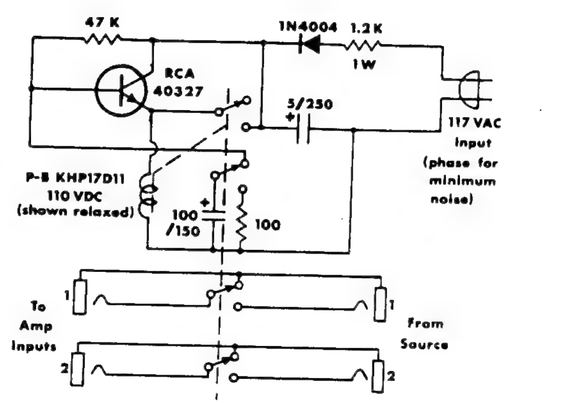


FIGURE 3-6
TURN-ON-TRANSIENT MUTER FOR LOAD PROTECTION

3.6 OPERATING PRECAUTIONS

The following operating precautions are given as an aid to understanding proper **and** improper amplifier usage:

1. Use care in making connections, selecting signal sources, and controlling the output level. The loudspeaker you save may be your own. CROWN is not liable for any damage done to loads due to careless amplifier usage or deliberate overpowering (CROWN speakers excepted). For pointers on load protection see paragraph 3.5.

2. Never parallel the two outputs by directly tying them together or parallel them with any other amp's output. Such connection does not result in increased power output. Damage incurred by such operation is not covered by the warranty.

3. Never drive a transformer-coupled device or any other device which appears as a low frequency short (less than 3 ohm) without a series isolating capacitor. Such operation may damage the device and/or needlessly waste output power.

4. Do not short the ground lead of an output cable to the input signal ground as oscillations may result from forming such a ground loop.

5. Never remove fuses with power applied.

6. Operate and fuse the amplifier only as set forth in paragraph 3.4.

7. Operate the amplifier from AC mains of not more than 10% above the selected line voltage and only on 50, 60, or 400Hz AC. Failing to comply with these limits will also invalidate the warranty.

8. Never connect the output to a power supply output, battery, or power main. Damage incurred by such a hookup is not covered by the warranty.

9. Do not expose the amplifier to corrosive chemicals such as soft drinks, lye, salt water, etc.

10. The amplifier is not recommended for high power industrial usage at frequencies above 20KHz.

11. Tampering in the circuit by unqualified personnel or the making of unauthorized circuit modifications invalidates the warranty.

12. Do not expose the output leads to areas likely to be struck by lightning. Such an installation could invalidate the amplifier.

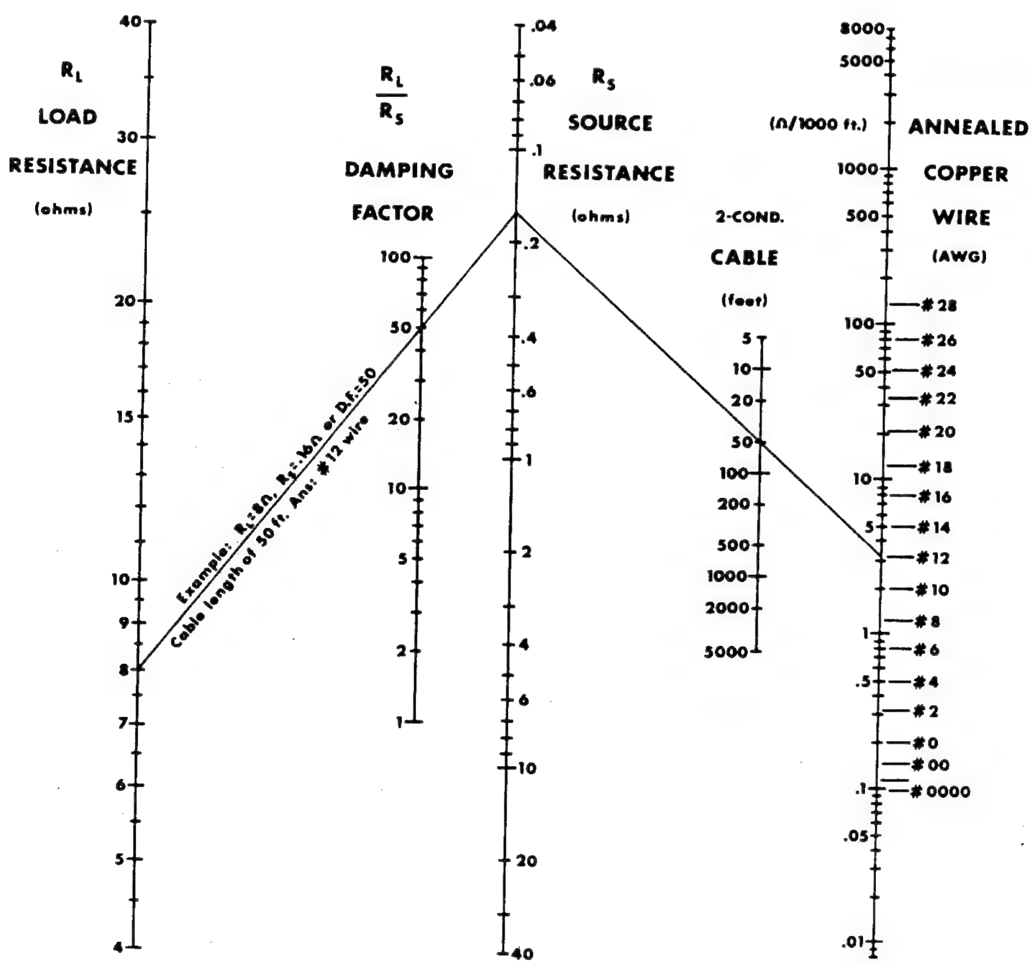


FIGURE 3-7
SOURCE RESISTANCE AND DAMPING FACTOR VS. LENGTH AND SIZE OF OUTPUT LEADS

3.7 CONNECTING OUTPUT LINES

Input and output connectors are located on the back of the chassis as shown in Figure 3-14.

It is always wise to remove power from the unit and turn the input level controls off while making connections, especially if the load is a loudspeaker system. This will eliminate any chance of loud blasts. **CROWN is not liable for damage incurred to any transducer due to its being overpowered! (CROWN speakers excepted.)**

Before making connections, it is recommended that the operator familiarize himself with the amplifier's protective system. Refer to paragraph 3.4.

Because of the location of the output connectors (color-coded binding posts), it will be easiest to make these connections first. High-quality, dual "banana" plugs are the preferred connections for permanent installations, critical applications, and when testing the amplifier.

Because the output wire gauge and length raises the resultant source impedance or lowers the Damping Factor by adding its series resistance, the nomograph (Figure 3-7) is provided for wire selection. For dynamic moving-coil loudspeakers the value of R_L should preferably be that measured by an ohmmeter across the voice coil, rather than the manufacturer's rating. For electrostatic speakers and such, the manufacturer's rated impedance should be used for R.

If the load (matching transformer, inductance, or full-range electrostatic speaker system) appears as a short-circuit at low frequencies, a large non-polarized capacitor (paralleled with a resistor) should be placed in series with the load.

For electrostatic speakers (if the manufacturer has not provided a capacitor) an external non-polar capacitor of 590-708 mfd and 4 ohm power resistor should be placed in series with the plus (+) speaker lead. This will prevent large low-frequency currents from damaging the electrostatic transformer or from unnecessarily activating the DC-300A's protective systems. An effective test to determine if such parts are needed is to measure the DC resistance between the output terminals with an ohmmeter. If the resistance is less than 3 ohms, the parts should be added as shown schematically in Figure 3-8.

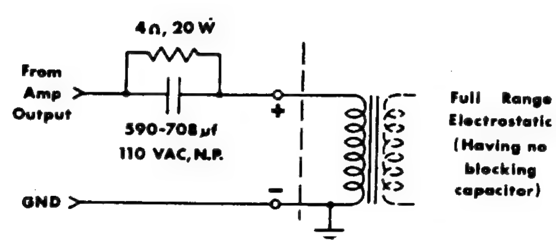


FIGURE 3-8
SCHEMATIC FOR FULL RANGE ELECTROSTATIC SPEAKER CONNECTIONS

When selecting connectors for the output lines, the following general precautions apply (with all power connectors):

1. A male plug, carrying signal, must not be on the far end of the line where it can be exposed, giving rise to both shock and short-circuit hazards.
2. Connectors which might accidentally cause the two channels to be tied together during making and breaking of connection should not be used. A common example is the standard 3-circuit ¼ inch phone jack and plug when wired for stereo sound.
3. Connectors which can be plugged into AC power receptacles should **never** be used.
4. Connectors having low-current-carrying capacity are "verboten."
5. Connectors having any tendency to short, or having shorted leads, are unadvisable.

Most commercially-available headphones employ a 3-circuit ¼-inch phone plug which violates condition number 2. This is no handicap if a pad is inserted between the amp and jack, which is the only sensible thing to do, when such a large amplifier is coupled to such a small transducer. If this precaution is ignored, not only may the transducer be burned out but permanent hearing loss could result. The recommended pad is shown in Figure 3-9.

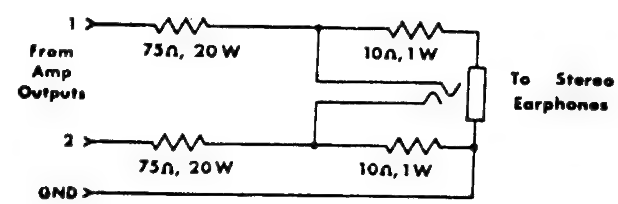


FIGURE 3-9
SCHEMATIC OF EARPHONE PAD

3.8 CONNECTING INPUT LINES

Connecting the inputs will require avoiding three basic dangers: Undesirable signals to the inputs, "ground loops," and feedback from output(s) to input(s).

For loudspeaker-driving applications, the input should be free of any DC, as this could cause overheating of the loudspeaker voice coil. A simple visual test for DC on the inputs (providing the woofer is visible) is to slowly turn up the input level control with the amp on and watch for any displacement of the cone. If very much displacement is observed, the DC content of the input may be excessive and require a blocking capacitor. The graph of Figure 3-10 indicates the effect of the size of the blocking capacitor on the frequency response. Only a low-leakage type paper, mylar, or tantalum capacitor should be used for this purpose.

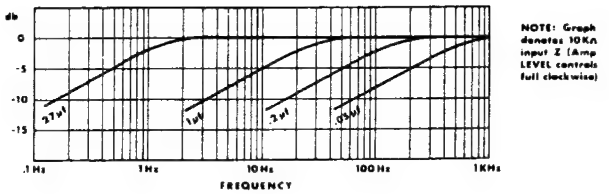


FIGURE 3-10
TABLE FOR SELECTION OF
INPUT DC BLOCKING CAPACITOR

If large amounts of untrasonic or RF frequencies are found on the input, such as bias from tape recorders, etc., a low-pass filter should be placed on the input. While practically-obtainable RF input levels will not damage the amplifier, they may cause burn-out of tweeters or other sensitive loads, activate the amplifier's protective systems, or cause general overload in the controlled-slewing-rate stage of the amp (which is employed to provide RF overload protection). The following filters are recommended for such applications.

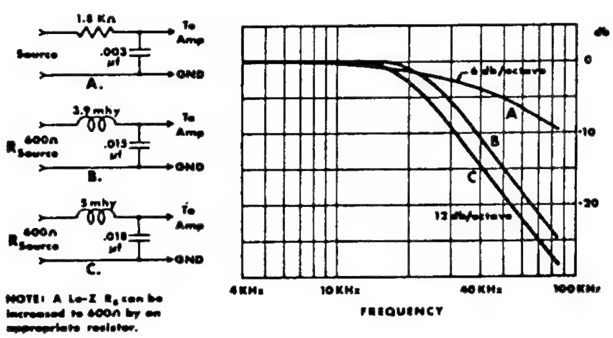


FIGURE 3-11
LOW-PASS FILTER FOR SEVERE RF AT INPUTS

A second problem area is "ground loops" — electronic jargon for undesirable circulating currents flowing in a grounding system. A common form of loop (possibly resulting in hum in the output) is a pair of input cables whose area is subjected to a magnetic hum field. In practice, both cables should lie together along their length, and away from the power transformer. Tying the input and output grounds together may also form a ground loop.

A third problem (with input and output grounds together, as in testing or metering) is feedback oscillation, from load current flowing in the loop. In industrial use, even the AC power line may provide this feedback path. Proper grounding, and isolation of inputs of common AC line devices is good practice. Refer to Section 5 for testing precautions.

An extremely common form of this problem is encountered when using electrostatic loudspeakers or any other kind of load that is joined to the AC power mains. Capacitive coupling through the load's supplies may allow the amplifier's output to be fed through the AC mains and into the grounds of input equipment resulting in a system oscillation.

To combat the problem, first try reversing the speaker leads on all channels if possible. If this does not solve the problem, try grounding the power amplifier to the AC ground with its 3 wire plug. (A ground loop may result through an FM tuner with an earth-grounded antenna system when deploying the 3 wire plug. The use of .005 uF disc capacitors in series with the FM antenna leads will eliminate this problem.) All hookup (interconnecting) cables should of course be as short as reasonably possible, and a turntable baseplate ground should always be brought to the phono preamp with a separate ground wire, never via the input cable ground. If the oscillation still persists, start removing input devices, working towards the amplifier until the oscillation disappears. This will identify the point of feedback. If an offending piece of equipment is found it should be inspected for unnecessary AC line-to-ground capacitances such as line filters, etc. If possible such should be removed. Such devices should never be found in the load, although it is true that some RF loudspeakers have used such filters to reduce RFI.

3.9 CONNECTING POWER

The amplifier is furnished with a three-wire AC plug as standard equipment. Adapters are readily available commercially for adapting this to a two-wire system if necessary.

The amplifier offers five standard line-voltage connections: 120, 128, 240, 248, and 256VAC. The tag attached to the line cord indicates for which voltage the amplifier is connected. Most units are connected for 120 VAC. If the amplifier is used on lines which at **any** time exceed 130VAC, the unit **must** be reconnected for 128VAC.

When testing the amplifier, the line voltage must be the peak equivalent to a sinusoid of the indicated line voltage when at full load. Line regulation problems can introduce serious errors in the measurements on an amplifier of this size.

Only a competent technician should attempt alteration of the line voltage connections.

In order to change the voltage, it is first necessary to carefully detach the bottom cover from the unit. On the back of the board-mount subchassis a terminal strip with solder-on jumpers is used to make the line-to-transformer primaries connections (see Figure 3-12).

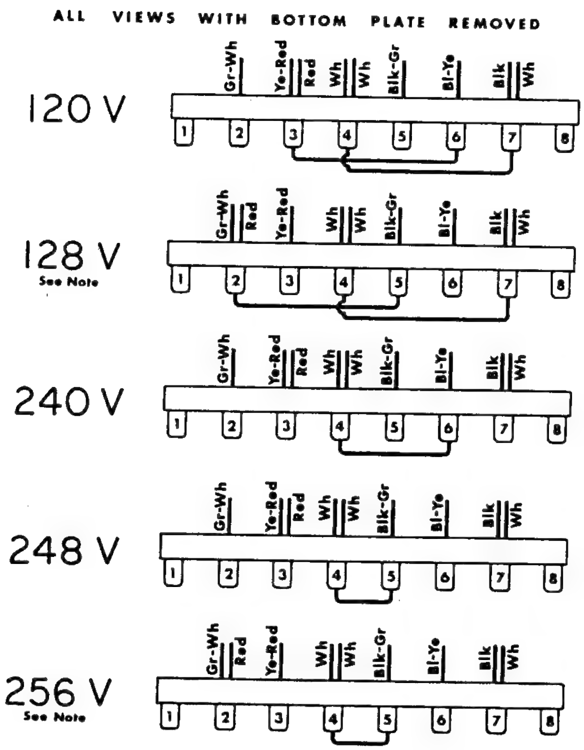
NOTE: The 128V and 256V connections require the changeover of the RED wire from TB-3 to TB-2. Therefore, the Front Panel, control circuit-board and shield must be carefully removed for access. When replacing shield, **use care** in locating so that **on-off switch locates properly in Front Panel opening!**

3.10 OPERATING CONTROLS

On the front panel are located independent level controls, a power switch, and pilot light. There is an AC line fuse on the rear of the unit.

The level control should be adjusted for the desired amplifier gain or output level. When the control is fully CW, the gain is 26db as determined by precision 1% resistors in the DC-300A's feedback loop.

The DC balance controls located behind the front panel seldom, if ever, need adjustment. **Only** in the most critical applications will they need adjustment (**not** "hi-fi" or similar applications). To adjust the DC balance controls, use the procedures in Section 5.



NOTE: The 128V and 256V connections require the changeover of the RED wire from TB-3 to TB-2. Therefore, the Front Panel, control circuit-board and shield must be carefully removed for access. When replacing shield, **use care** in locating so that **on-off switch locates properly in Front Panel opening!**

FIGURE 3-12
TABLE OF LINE VOLTAGE CONNECTIONS

3.11 NORMAL HI-FI INSTALLATION

1. Remove output covers, exposing dual binding-posts. Two-conductor speaker cables must connect to the OUTPUTS using terminal lugs, tinned ends, or the special "banana" plugs supplied with the DC-300A. Connect the in-line fuses as recommended in the Accessory Bag and Figure 3-14. (Not needed with CROWN speakers.)

2. Since the DC-300A is a "basic amplifier," the main outputs of the control-center or "preamplifier" must be connected via shielded audio-cables to the two jacks marked INPUT. Use RCA-pin at preamp and standard ¼ inch phone-plug at the DC-300A.

   The two cables should be tied parallel along their entire length, using the accessory cable ties.

FIGURE 3-13
AMPLIFIER OPERATING CONTROLS

3. U/L requirements specify a 3-wire AC power connector; however, proper connections to a switched outlet on the control center require the use of a 3-to-2 wire adapter. NOW, plug the AC into a **switched** outlet on the control center.

4. Your Control Center may now be turned on. Then advance the DC-300A Input-Gain Controls about ½-open (150° clockwise).

   When using the CROWN IC-150 Control-Center, the LOUDNESS should attain almost full rotation (2 to 4 o'clock) for loudest "concert-hall" volume. If at 3 o'clock the volume is low, increase the DC-300A input gain controls; if too high, decrease the DC-300A gains.

   To assure maximum enjoyment and full speaker protection, read the detailed sections on OUTPUTS, INPUTS and OPERATION.

3.12 CLEANING

The CROWN DC-300A has a rugged anodized front panel for lifetime service. The panel can be cleaned with a moist cloth and mild detergent. Never use steel wool, scouring powder, lye solution, or any strong abrasive cleaner as these will damage the panel's finish.

The back chassis should require no more cleaning than periodic dusting with a clean dry cloth. The use of detergents, abrasives or other cleaners may remove the fine film of oil from the black anodized chassis which is used to increase its surface lustre.

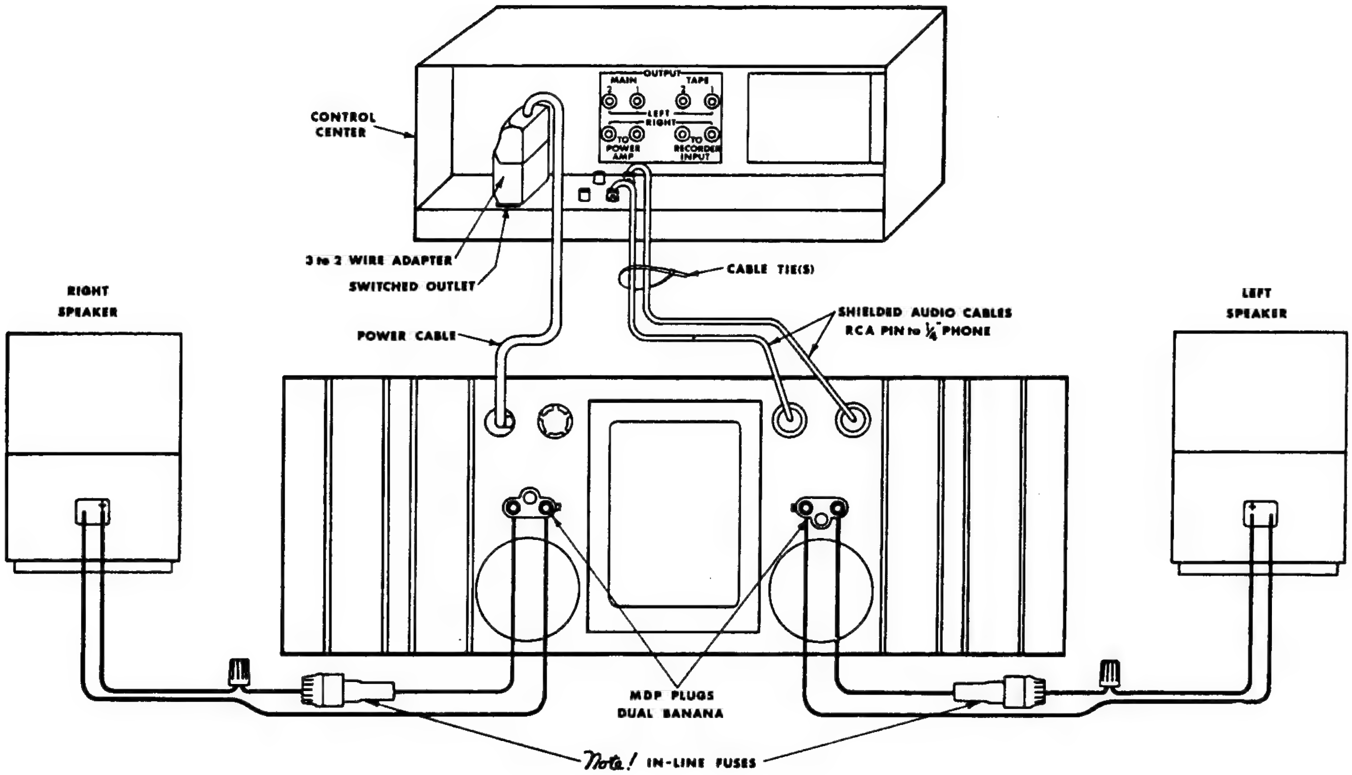


FIGURE 3-14
NORMAL HI-FI HOOK-UP

4.1 GENERAL

This section contains a description of circuitry operation to better enable a qualified service technician to understand and maintain the CROWN DC-300A amplifier in optimum operating condition. Refer to the amplifier schematic diagram in Section 6 while reading the circuitry explanation to facilitate your understanding of the amplifier operation.

4.2 PRINCIPLES OF OPERATION

The DC-300A has two totally direct-coupled amplifier circuits which employ a dual IC op amp and silicon transistors in all stages. The CROWN designed and developed circuit represents a level of quality and performance presently unequaled in the field of audio amplifier design.

As is implicit in the term "totally direct-coupled," the DC-300A has a perfectly flat frequency and phase response extending to 0 Hz or DC. Flat to DC response results in not only low frequency amplification with absolutely no phase-distortion, but also in perfect overload characteristics. Non-symmetrical waveforms (such as music) cause overload thumping in all currently produced AC amplifiers. These same amplifiers may, however, show no signs of thumping when fed a symmetrical test waveform such as a sinusoid. DC frequency response combined with ultra-low noise and IM distortion results in the closest approach to a "straight wire with gain."

The dual IC op amp is of a low noise type having a large gain bandwidth. The result of using it for the input voltage amplifier is that a maximum amount of feedback is applied reducing distortion to record low values. The typical full outout (150w, 8 ohms) SMPTE IM is 0.002%. This implies that the full power THD is in the vicinity of 0.0005%. This has been confirmed by measurement with an elaborate test setup employing CROWN-developed state variable filters and wave analyzing equipment. No other presently available harmonic distortion test apparatus is capable of such low residuals. The 300A's low distortion is achieved by employing multiple feedback loops to allow a maximum of total feedback.

The lack of noise is evidenced by a typical 20Hz - 20KHz effective input noise of 1.25 u volts which produces an effective 8 ohm output of 80 micro-micro (pica) watts.

The output stage is a quasi-complementary format employing the CROWN class AB+B technique which uses no bias current in the output transistors. The result is maximum efficiency with minimum crossover notch distortion and amplifier idling-heat. Thus there is no bias current adjustment, as the output circuit is not temperature-tolerance critical. Temperature drifts of bias are further controlled by bias servos which are mounted on the heat sinks.

In the AB+B output circuit, the driver transistors carry the bias current, while the output transistors serve only as boosters. The output transistors (1200W dissipation/Ch) sense when the driver transistors are delivering significant current to the load and take over and deliver the large load currents.

Protection against shorted and low impedance loads is provided by the CROWN-developed SPACE (Signal Programmed Automatic Current Executor) control circuit. It functions as an automatic current limiter at audio frequencies and as a VI limiter at subaudio frequencies. The threshold of current limiting is dependent on the history of the signal, yet the no-signal threshold of current limiting is high enough to allow full power tone bursting. The net result is total protection with a maximum of headache-free output power requiring neither an inventory of special fuses or cumbersome load matching techniques.

The monolithic input amplifier stages result in extremely low DC drift. The input terminal bias current is offset by a unique temperature compensated source resulting in a laboratory amplifier needing no user-accessible offset controls.

The input amplifiers are powered by zener-regulated power supplies. The bias regulators are also powered by zener-regulated current sources with the result that line voltage variations do not cause noise or distortion due to misbiasing.

The power supply is a continuous-duty type, capable of 1 KW loading. The power transformer, weighing 25 pounds, is constructed of special grain-oriented steel. The main DC supplies are full-wave capacitor input type with heavy-duty, chassis heat-sinked diodes. Computer grade electrolytics furnish over 48 joules of energy storage. A higher voltage at low current is derived from a half-wave voltage-doubler circuit. This voltage is used in the amplifier's driver circuit.

The DC-300A represents nothing short of the highest quality in both circuitry and components. It should provide a lifetime of trouble-free service for the most discriminating users.

4.3 OUTPUT CIRCUITRY

The output transistors (Q210-Q213) draw no current in the quiescent state. The driver transistor (Q209) is biased on in the quiescent state, however, the bias current is not sufficient to turn on the outputs. Any demand for large amounts of current from Q209 causes the voltage across bias resistor R232 to rise, turning on output transistors Q210-213 and supplying the heavy current through resistors (R233, 235, 236, 237) required for high power operation.

Predriver (Q206) is a complementary stage cascaded with driver (Q209) to provide sufficient current gain to turn on the outputs. The bias voltage supply acts as a current source to bias Q206 which in turn biases Q209.

The bias level voltage is adjusted by changing the value of the selected bias resistor (R229) until a bias voltage of 310-345 mv appears across bias resistor R232 in the emitter circuit of driver Q209. Refer to Section 5 for detailed procedure for selecting the appropriate value for resistor R229.

4.4 PROTECTION CIRCUITS

Resistors (233, 235, 236, 237) are positive current sensing resistors which carry the output current from output transistors (Q210-Q213). Before the output current becomes dangerously high, the voltage induced across these resistors turns on the positive limiting transistor Q202. This action cuts off the drive voltage for predriver Q206 which in turn limits the signal level whenever it threatens to push the output transistors too hard. When the predriver current plus the limiter current equals the current available from the voltage amplifier (Q201) a limit point is reached and the protection mechanism remains in this state until the overload at the output is removed. This limiting action occurs at the instant an overload appears at the output and removes itself when the overload is removed.

4.5 LVA, LVA CURRENT SOURCE AND BIAS SERVO CIRCUITS

A 42 VAC voltage from the primary power supply is applied to voltage doubler circuit D1-D2 to produce a zener-regulated +70 VDC for use in the amplifier driver/output circuitry. The current path for the last voltage amplifier/bias servo circuits is through LVA (Q104, Q204), bias servo (Q108, Q208) LVA current source (Q101, Q201) to the +70 VDC supply. This current is available at the base circuit of pre-drivers (Q106, Q206, Q107, Q207). Q105 and Q205 are LVA limiters tied to the -60 VDC supply. C114 and C214 are amplifier slew rate limiting capacitors.

4.6 INPUT CIRCUITRY

The signal at the input jacks is applied through level controls (R100, R200) to the dual IC operational amplifier IC1. The output of IC1 is fed to signal translator (Q100, Q200) where it is amplified for use in the ±60V output circuits and applied to the base circuit of LVA (Q104, Q204).

A +5V reference voltage from the collector of input bias compensator, Q1, is used to adjust the input offset voltage (R103, R203).

±10V reference voltages, derived from voltage dividers (R3/D4 for +10V; R8/D5 for -10V) and the ±60V supplies are used to adjust the output offset voltage (R105, R205). The ±10V voltages are also used to supply operating power to the IC.

5.1 INTRODUCTION

This section contains technical information required to properly service and repair the CROWN DC-300A Laboratory Power Amplifier. Included are disassembly and reassembly procedures, a troubleshooting chart (for isolating and identifying defective components), adjustments, test setups and procedures, and component replacement procedures. Use this information in conjunction with Section 6, Schematics, Parts Lists and Component Location, to obtain best results.

5.2 SERVICE POLICIES

Due to the sophisticated circuitry, only a fully-trained competent service technician should be allowed to service the DC-300A amplifier. User servicing should be confined to routine replacement of the fuse on the rear panel or replacement of damaged level control knobs on the front panel. Please observe the following label on top of the amplifier chassis cover.

CAUTION. TO PREVENT ELECTRIC SHOCK, DO NOT OPEN. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO A QUALIFIED TECHNICIAN.

For other service, it is recommended that the unit be returned to the factory in the original packing or replacement packing obtained from the CROWN factory. The CROWN warranty is described in paragraph 5.3. For warranty service the unit must be returned to the factory or approved warranty stations.

Before returning a CROWN DC-300A amplifier to the factory for service, authorization should be obtained from the service manager. All shipments must be sent by UPS, Railway Express or Truck Freight, prepaid and insured at total value. The factory will return your serviced unit by UPS, Railway Express or Truck Freight.

5.3 WARRANTY

CROWN guarantees this equipment to perform as specified. CROWN also warrants the components and workmanship of this equipment to be free from defects for a period of 90 days from date of purchase.

This warranty does not extend to fuses, and/or component or equipment damage due to negligence, misuse, shipping damage or accident; or if the serial number has been defaced, altered or removed.

An application for a FREE 3-year WARRANTY TITLE is included with the instruction manual received with the equipment. Upon receipt of this completed form, CROWN will issue the Warranty Title — subject to the conditions contained therein. This title applies to the original end-purchaser and will be issued only upon receipt of the application.

5.4 DISASSEMBLY FOR SERVICING

The DC-300A amplifier is specifically designed for easy servicing. It may be partially disassembled and still be made operational for bench testing and servicing. This may be accomplished by removing the front panel and chassis cover (par. 5.4.1).

These two steps provide easy access to nearly all major components of the amplifier. Those that are not accessible for servicing can be removed following the procedures given for replacing individual assemblies.

CAUTION!

DO NOT attempt component replacement or other repairs with power applied.

5.4.1 REMOVAL OF FRONT PANEL AND CHASSIS COVER

Refer to Figure 6-3.

1. Remove power from the amplifier.
2. Place amplifier on bench, front panel up.
3. Remove four screws (10), two from each end of the front panel.
4. Remove eight screws (11), four each from the top and bottom of the front panel.
5. Remove two level control knobs (setscrew), hex nuts and washers (13).
6. Carefully lift the front panel and disengage level control shafts and keys from the front panel holes.
7. Remove eight screws (2), and remove chassis cover from the main chassis.

Reverse above sequence of actions to reassemble amplifier.

5.4.2 REMOVAL OF CHASSIS COVER ASSEMBLY

Refer to Figure 6-8.

1. Remove front panel (par. 5.4.1).
2. Disconnect two Faston connectors and two crimped connectors from the bridge (2) terminals.
3. Remove eight screws (7) and remove chassis cover assembly from the amplifier chassis.
4. Reverse above sequence of actions to replace chassis cover assembly.

5.4.3 REPLACEMENT OF COMPONENTS ON DCA MAIN PC BOARD ASSEMBLY

Refer to Figure 6-4.

1. Remove front panel and chassis cover (par. 5.4.1).

2. Remove four hex head screws from top of DCA main PC board corners.

3. Carefully lift edge of PC board adjacent to power switch and rotate board approximately 90° toward bottom of amplifier. Do not place unnecessary strain on cable assemblies which are located generally along the bottom edge of the PC board. The foil and solder side of the board is now accessible.

5.4.4 REPLACEMENT OF LEVEL POTENTIOMETER (R100, R200)

Refer to Figure 6-3.

1. Remove front panel (par. 5.4.1).

2. Unsolder two white wires and shield from potentiometer.

3. Replace potentiometer and resolder wires and shield.

5.4.5 REPLACEMENT OF POWER SWITCH, SW-1

Refer to Figure 6-6.

1. Remove front panel (par. 5.4.1) and chassis cover assembly (par. 5.4.2).

2. Use an offset Phillips screwdriver and loosen two screws beneath the power switch on the bottom of the shield assembly.

3. Remove power switch and associated hardware.

4. Separate halves of power switch and disconnect three wires (white, black and red).

5. Reconnect three wires to new power switch.

6. Replace new power switch and associated hardware in original position on shield assembly.

5.4.6 REPLACEMENT OF THERMAL SWITCH (SW-2, SW-3)

Refer to Figure 6-5.

1. Remove front panel (par. 5.4.1).

2. Disconnect two Faston connectors from thermal switch terminals.

3. Remove two screws on rear of main heatsink chassis.

4. Remove defective thermal switch and associated hardware.

5. Install new thermal switch and associated hardware.

6. Reconnect two Faston connectors to thermal switch.

5.4.7 REPLACEMENT OF BRIDGE, DM-1

Refer to Figure 6-8.

1. Remove front panel (par. 5.4.1).
   NOTE: It is not necessary to unsolder any wires connected to the bridge terminals.

2. Disconnect two Faston connectors and two crimped connectors from the bridge terminals.

3. Remove mounting screw⑥, hex nut⑤, bridge②, and washer④.

4. Unsolder capacitor③ from bridge and resolder on the new bridge.

5. Replace bridge and mounting hardware.

6. Replace four connectors on bridge terminals.

5.4.8 REPLACEMENT OF FILTER CAPACITOR (C1 or C2)

Refer to Figure 6-9.

1. Remove front panel and chassis cover (par. 5.4.1).

   NOTE: It is not necessary to unsolder any wire connections to the capacitor.

2. Remove filter capacitor hardware as pictured and remove capacitor from chassis mounting holes.

3. Install new capacitor and replace hardware.

5.4.9 REPLACEMENT OF OUTPUT COIL (L101, L201)

Refer to Figure 6-10.

1. Remove front panel and chassis cover (par. 5.4.1).

2. Unsolder two leads of magnetic wire from the coil; one at the heatsink board, one at the output connector.

3. Remove hex nut⑦, star lockwasher⑥, washer④ and coil form with magnetic wire.

4. Install new coil (with magnetic wire) and replace hardware removed in step 3.

5. Resolder two magnetic wire leads at locations indicated in step 2.

5.4.10 REPLACEMENT OF OUTPUT AND DRIVER TRANSISTORS

Refer to Figure 6-8.

1. Remove amplifier front panel and chassis cover (paragraph 5.4.1).
   NOTE: Refer to Figure 6-5, Heatsink Board Assembly, for location of output and driver transistors.
2. Remove perforated transistor cover (10) covering transistor to be changed.
3. On heatsink board, unsolder and tag for identification, wires connected to transistor terminals.
4. Refer to detail drawing of output and driver transistors (Figure 6-8) and remove hardware shown and the transistor.
   NOTE: When removing hardware be sure to hold the hex nut with a ¼" nut driver, and turn the screw with a screwdriver. This prevents the #6 star washer from turning and damaging the foil on the heatsink board.
5. Coat both sides of the insulator between the transistor case and the heatsink with a heat-conducting compound (DC-340).
6. Install new transistor and tighten screws and hex nuts snugly and evenly to assure good heatsinking.
7. Resolder wires removed from transistor terminals in Step 3 above.
8. Replace perforated transistor cover (10).
9. Replace amplifier front panel and chassis cover (paragraph 5.4.1).

5.5 TEST EQUIPMENT

The DC-300A amplifier is a relatively complex unit, and consequently requires a comprehensive array of standard and special test equipment for complete servicing. A recommended list of equipment is shown in Table 5-1.

In the absence of a complete set of test equipment, it should be noted that most troubleshooting can be successfully done with an oscilloscope, an ohmmeter, a voltmeter, and a signal generator. Any amplifier malfunctions which cannot be identified and repaired with this basic equipment should be referred to the CROWN factory or authorized service center.

5.5.1 CALIBRATION OF TEST EQUIPMENT

It is important that test measurements made during servicing be accurate and dependable. Otherwise the performance of the amplifier cannot be properly evaluated. Test equipment shown in Table 5-1 should remain properly calibrated with only periodic checks (6 month intervals). If less expensive (and thereby less dependable) test equipment is used, frequent calibration is necessary to assure the accuracy required for proper servicing.

5.6 TEST PROCEDURES

This paragraph lists precautions essential to obtain accurate test measurements when dealing with high-purity amplifiers such as the DC-300A amplifier.

1. Use the proper line voltage (120 VAC or 240 VAC) for which the power supply has been wired for normal operation. The line voltage should be measured with a peak reading AC voltmeter and adjusted to the rms equivalent voltage (to compensate for line voltage regulation errors during the course of the test measurements).
2. The loads should be resistive, having less than 10% reactive components at any frequency up to five times the highest test frequency. All output measurements should be taken at the output terminals and not at any other points along the output cables through which the load current is flowing.
3. The input level controls should be set to maximum for all distortion tests to assure repeatability of all measurements.
4. When measuring hum and noise, all inputs should be disconnected from the amplifier and the level controls set to minimum or to maximum, preferably minimum.
5. Whenever possible avoid ground loops in the test equipment caused by connecting the output ground to the input ground. **Never** connect the ground of the cable going to the load back to the input ground.

   Ground loops are especially obnoxious when measuring distortion. An IM distortion analyzer, for example, has its input and output terminals tied to a common ground. Such a test should use an ungrounded output return, with the output lead(s) wrapped around the well-shielded and grounded input cable.
6. Always monitor the test oscillator when measuring frequency response. Use a wide-band AC voltmeter; or use the same meter for both input and output level measurements, if the meter's frequency response is known not to be dependent on attenuator settings.
7. Accuracy in measuring voltages for computing wattage is critical. For example, a 2% voltage error together with a 1% resistance error can result in an error of 10 watts power into an 8-ohm load.
8. Residual distortion and noise levels should be fully known for all the test equipment in order to accurately evaluate the amplifier.
9. Never attempt to measure damping factor by placing abnormal loads on the output. DF measurements taken during clipping, or any other form of overload, are meaningless. The preferred method is to apply an externally generated current to the output terminals and measure the resultant voltage at the terminals. A convenient current is one ampere — as the resultant voltage will read directly in ohms for (Z_O). Damping factor is defined as (Z_L/Z_O), where (Z_L) is typically 8 ohms. A convenient generator for the 1A current is that amplifier channel not under test. A non-inductive resistance of 8 ohms — coupled between both channels' output ter-

TABLE 5-1. TEST EQUIPMENT

EQUIPMENT	REQUIREMENTS	APPLICATION	SUGGESTED MODEL
Oscilloscope	Capable of displaying a 10 megahertz signal.	Monitoring output during service and testing.	Telequipment SS4A or equivalent.
Voltohmmeter (VOM)	Low-voltage resistance probe (100mv range). High-voltage resistance probe (1.5 v range).	Check resistance values (low voltage probe). Check semiconductor junctions for opens or shorts (high voltage probe). Check DC voltages.	Triplett 601 or equivalent
Signal Generator	Sine/square wave available; flat frequency response.	Provide test signals for service and checkout. (10KHz sq; 20KHz sine)	Wavetek 130-Series or equivalent
Wattmeter	Reasonable accuracy at 20W without cutting into voltage at high power levels.	Check power consumption.	Simpson 390 (panel meter 1379) or equivalent
Power Supply	±60V available; current limits to 125 ma; reasonably accurate at 50 ma.	Preliminary checkout of fuse-blowing amplifiers.	Lambda LPD 423 FM or equivalent
Circuit Breaker	15 ampere rating.	In AC line to amplifier; protects circuitry from overload if power supply has shorted.	
AC Line Monitor	Peak reading meter.	Monitor line voltage for amplifier testing.	Information available from CROWN.
Variac		Keep line voltage at 120V during tests.	Superior Powerstat 116B or equivalent.
AC Voltmeter	100 mv low range.	Set output level for testing; check noise level.	Hewlett-Packard 400F or equivalent
Filter	20-20KHz bandpass, low noise.	Between amplifier and voltmeter in noise test.	Information available from CROWN.
Intermodulation Distortion Analyzer		Check IM distortion from 150W to 15 MW.	Available from CROWN
Dummy Load	2, 4, 8 Ohm; able to dissipate 500W without strain; less than 10% reactive component at any frequency up to 5 times the highest test frequency. (100KHz x 5 = 500KHz)	Check amplifier performance under load.	Information available from CROWN.

5.4.10 REPLACEMENT OF OUTPUT AND DRIVER TRANSISTORS

Refer to Figure 6-8.

1. Remove amplifier front panel and chassis cover (paragraph 5.4.1).
   NOTE: Refer to Figure 6-5, Heatsink Board Assembly, for location of output and driver transistors.
2. Remove perforated transistor cover (10) covering transistor to be changed.
3. On heatsink board, unsolder and tag for identification, wires connected to transistor terminals.
4. Refer to detail drawing of output and driver transistors (Figure 6-8) and remove hardware shown and the transistor.
   NOTE: When removing hardware be sure to hold the hex nut with a ¼" nut driver, and turn the screw with a screwdriver. This prevents the #6 star washer from turning and damaging the foil on the heatsink board.
5. Coat both sides of the insulator between the transistor case and the heatsink with a heat-conducting compound (DC-340).
6. Install new transistor and tighten screws and hex nuts snugly and evenly to assure good heatsinking.
7. Resolder wires removed from transistor terminals in Step 3 above.
8. Replace perforated transistor cover (10).
9. Replace amplifier front panel and chassis cover (paragraph 5.4.1).

5.5 TEST EQUIPMENT

The DC-300A amplifier is a relatively complex unit, and consequently requires a comprehensive array of standard and special test equipment for complete servicing. A recommended list of equipment is shown in Table 5-1.

In the absence of a complete set of test equipment, it should be noted that most troubleshooting can be successfully done with an oscilloscope, an ohmmeter, a voltmeter, and a signal generator. Any amplifier malfunctions which cannot be identified and repaired with this basic equipment should be referred to the CROWN factory or authorized service center.

5.5.1 CALIBRATION OF TEST EQUIPMENT

It is important that test measurements made during servicing be accurate and dependable. Otherwise the performance of the amplifier cannot be properly evaluated. Test equipment shown in Table 5-1 should remain properly calibrated with only periodic checks (6 month intervals). If less expensive (and thereby less dependable) test equipment is used, frequent calibration is necessary to assure the accuracy required for proper servicing.

5.6 TEST PROCEDURES

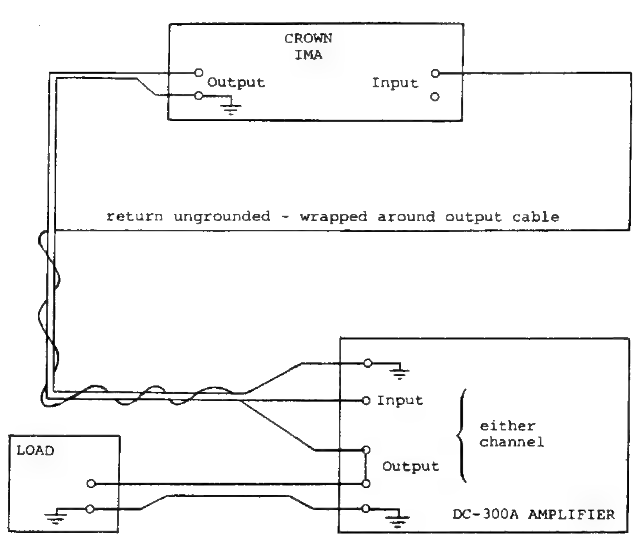
This paragraph lists precautions essential to obtain accurate test measurements when dealing with high-purity amplifiers such as the DC-300A amplifier.

1. Use the proper line voltage (120 VAC or 240 VAC) for which the power supply has been wired for normal operation. The line voltage should be measured with a peak reading AC voltmeter and adjusted to the rms equivalent voltage (to compensate for line voltage regulation errors during the course of the test measurements).
2. The loads should be resistive, having less than 10% reactive components at any frequency up to five times the highest test frequency. All output measurements should be taken at the output terminals and not at any other points along the output cables through which the load current is flowing.
3. The input level controls should be set to maximum for all distortion tests to assure repeatability of all measurements.
4. When measuring hum and noise, all inputs should be disconnected from the amplifier and the level controls set to minimum or to maximum, preferably minimum.
5. Whenever possible avoid ground loops in the test equipment caused by connecting the output ground to the input ground. **Never** connect the ground of the cable going to the load back to the input ground.

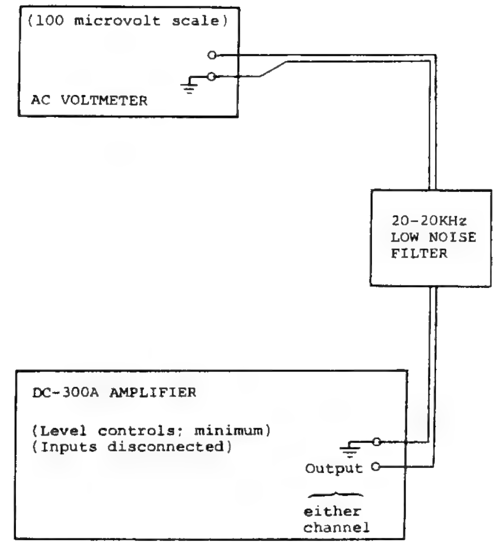
   Ground loops are especially obnoxious when measuring distortion. An IM distortion analyzer, for example, has its input and output terminals tied to a common ground. Such a test should use an ungrounded output return, with the output lead(s) wrapped around the well-shielded and grounded input cable.
6. Always monitor the test oscillator when measuring frequency response. Use a wide-band AC voltmeter; or use the same meter for both input and output level measurements, if the meter's frequency response is known not to be dependent on attenuator settings.
7. Accuracy in measuring voltages for computing wattage is critical. For example, a 2% voltage error together with a 1% resistance error can result in an error of 10 watts power into an 8-ohm load.
8. Residual distortion and noise levels should be fully known for all the test equipment in order to accurately evaluate the amplifier.
9. Never attempt to measure damping factor by placing abnormal loads on the output. DF measurements taken during clipping, or any other form of overload, are meaningless. The preferred method is to apply an externally generated current to the output terminals and measure the resultant voltage at the terminals. A convenient current is one ampere — as the resultant voltage will read directly in ohms for (Z_O). Damping factor is defined as (Z_L/Z_O), where (Z_L) is typically 8 ohms. A convenient generator for the 1A current is that amplifier channel not under test. A non-inductive resistance of 8 ohms — coupled between both channels' output ter-

TABLE 5-1. TEST EQUIPMENT

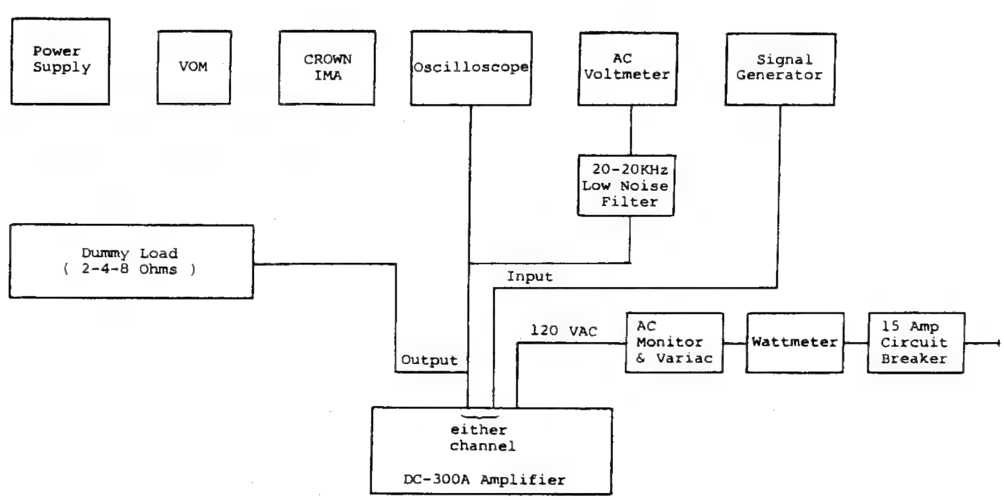
EQUIPMENT	REQUIREMENTS	APPLICATION	SUGGESTED MODEL
Oscilloscope	Capable of displaying a 10 megahertz signal.	Monitoring output during service and testing.	Telequipment SS4A or equivalent.
Voltohmmeter (VOM)	Low-voltage resistance probe (100mv range). High-voltage resistance probe (1.5 v range).	Check resistance values (low voltage probe). Check semiconductor junctions for opens or shorts (high voltage probe). Check DC voltages.	Triplett 601 or equivalent
Signal Generator	Sine/square wave available; flat frequency response.	Provide test signals for service and checkout. (10KHz sq; 20KHz sine)	Wavetek 130-Series or equivalent
Wattmeter	Reasonable accuracy at 20W without cutting into voltage at high power levels.	Check power consumption.	Simpson 390 (panel meter 1379) or equivalent
Power Supply	±60V available; current limits to 125 ma; reasonably accurate at 50 ma.	Preliminary checkout of fuse-blowing amplifiers.	Lambda LPD 423 FM or equivalent
Circuit Breaker	15 ampere rating.	In AC line to amplifier; protects circuitry from overload if power supply has shorted.	
AC Line Monitor	Peak reading meter.	Monitor line voltage for amplifier testing.	Information available from CROWN.
Variac		Keep line voltage at 120V during tests.	Superior Powerstat 116B or equivalent.
AC Voltmeter	100 mv low range.	Set output level for testing; check noise level.	Hewlett-Packard 400F or equivalent
Filter	20-20KHz bandpass, low noise.	Between amplifier and voltmeter in noise test.	Information available from CROWN.
Intermodulation Distortion Analyzer		Check IM distortion from 150W to 15 MW.	Available from CROWN
Dummy Load	2, 4, 8 Ohm; able to dissipate 500W without strain; less than 10% reactive component at any frequency up to 5 times the highest test frequency. (100KHz x 5 = 500KHz)	Check amplifier performance under load.	Information available from CROWN.



IM DISTORTION TEST SETUP *B*



NOISE TEST SETUP *C*



TYPICAL TEST BENCH SETUP FOR DC-300A AMPLIFIER *A*

FIGURE 5-1 TEST EQUIPMENT COMPLEMENT

minals — will provide 1A when 8 volts are impressed across the resistor (by that channel not under test).

10. Never measure hum and noise when in the presence of strong magnetic fields. The amplifier should be at least 4 inches away from any large metallic objects or shield plates for a reading to be meaningful.

11. Noise measurements should be taken with a bandpass filter of 20-20KHz. For audio purposes the measurement of noise above 20KHz is unimportant.

12. When repairing an amplifier it should not normally be operated with a load until it performs properly unloaded. If serious problems with the amplifier exist, a load will only compound those problems by blowing fuses and causing additional damage by drawing high current.

13. Ohmmeter tests can usually be performed on semi-conductors with the 1.5 volt probe. On the RX1 scale, the normal forward breakdown resistance for semi-conductors will usually fall in the 5-15 ohms range.

To check resistor values without removing them from the circuit and without forward biasing any junctions, the low voltage probe (100 mv range) should be used.

The effect of parallel resistance paths must be considered in determining whether a test reading is normal. The simplest procedure is a comparison with the same reading under identical conditions on a properly functioning channel. If both channels are defective, compare the readings with those on a good amplifier.

Approximate resistance measurements for transistors (outside a circuit) appear below. Large resistance means little or no indication on the RX1 ohms scale. Base-emitter and base-collector readings in a transistor should match within several ohms. The first lead in the list below takes the positive meter probe for an NPN transistor; the negative meter probe for a PNP transistor.

Base-emitter	5-15 ohms
Emitter-base	Large
Base-collector	5-15 ohm
Collector-base	Large
Collector-emitter	Large
Emitter-collector	Large

Diodes should show approximately 5-15 ohms forward resistance and large reverse resistance.

Know your ohmmeter — all types do not operate the same. Some have the positive lead common, others the negative. You must be aware of this when measuring forward or reverse junction resistances. Some meters use a nine-volt test voltage on high resistance scales which can forward bias enough junctions in a solid state circuit to cause avalanche confusion. Know the test voltage for the scale used.

5.7 TROUBLESHOOTING

The information contained in the troubleshooting chart has been compiled from data gathered from field service reports and factory experience. It contains symptoms and usual causes for the service problems described, however, do **not** assume that these are the only problems that may occur. The DC-300A amplifier is a complex piece of electronic equipment and all available data concerning the reported trouble should be systematically analyzed before undertaking any drastic repairs or component replacement procedures. The following general procedure should be used in servicing the DC-300A.

a. Verify and Identify the Problem

Assemble and analyze all data accompanying the amplifier. Do **not** automatically assume that the amplifier is, in fact, defective. Problems arising from the system configuration in which the amplifier is being used may be blamed on the amplifier. Most written complaints are sketchy, sometimes ambiguous, and generally tend to oversimplify problems. Some problems may be painfully obvious — blown fuses, broken parts, or the smell of burned components. Should the problem not be simple to find, it may be helpful to contact the user directly and ask the following questions:

(1) What are the details of the system in which the amplifier was being used? Has the system been carefully checked for possible problems outside the amplifier?

(2) Describe the problem? Symptoms? One channel affected or both? Which channel?

(3) Did the problem occur more than once? Were circumstances identical for all occurrences?

(4) What kind of input signal and load were used?

(5) How long was the amplifier in operation when the failure occurred? Was it warmer than usual?

If the user is not available and the problem is not obvious, perform the regular factory checkout procedure. The troubleshooting chart is organized according to the sequence of the factory checkout procedure and common service problems appear in the order they are most likely to occur.

b. Visual Inspection

A detailed visual inspection is worth performing for almost all problems and may avoid unnecessary additional damage to the amplifier.

(1) Check for loose wires and wires that may be crimped or squeezed against components or the chassis in assembly. Suspicious wires should be pulled gently to assure they are securely fastened.

(2) Check for loosened screws holding wiring connections.

(3) Check for bad solder connections. Loose transistor leads may cause oscillation, noise or DC imbalance.

(4) Check for parts damaged by heat or high power. This is usually apparent by discoloration or burned odor.

5.7.1 TURN-ON PROCEDURE

Plug in the DC-300A amplifier with no signal input and no load. Depress power switch to apply AC line voltage.

SYMPTOM	PROBABLE CAUSE AND REMEDY
AC fuse blown.	Wrong size fuse. Replace with correct value.
	Wrong line voltage. Check AC line voltage.
	Pinched wires in power supply. Make visual check of power supply wiring. See Schematic.
	Short in power cord or transformer primary. Make ohmmeter check of power cord for hot-to-ground short (with switch ON, contacts of plug should show about .35 ohms). This is transformer primary resistance; it should not be zero.
	Miswiring of transformer primary. Check primary wiring according to color code on schematic.
	Short in rectifier bridge, DM1. Replace.
No AC power; fuse OK	Defective power switch. Replace.
	Defective thermal switch. Replace.

5.7.2 INPUT/OUTPUT OFFSET VOLTAGE CHECK

Check the input/output offset voltages for both channels. If voltage exceeds 10 mv, perform adjustment according to paragraph 5.8.2. If unable to adjust properly, check:

SYMPTOM	PROBABLE CAUSE AND REMEDY
Offset voltage out of tolerance	Check + and - 10V power to IC. If bad check D4 and D5.
	Check IC; if defective, replace.
	C5 leaky or shorted. Replace. C5 may not become leaky until amplifier is thoroughly warmed up. When C5 is shorted, R1 and C4 have usually been overheated and should be replaced.
	Check +5V offset reference voltage at the collector of Q1. If bad, check Q1 and associated components.
	Check grounds associated with offset circuitry.

5.7.3 BIAS LEVEL CHECK

Check the bias level voltage. If voltage does not fall within specified limits (310-345 mv), perform adjustment according to paragraph 5.8.1. If unable to adjust properly, check:

SYMPTOM	PROBABLE CAUSE AND REMEDY
Low or no bias	Check components in voltage doubler current source circuitry (D1, D2, D3, C4, C5, R1, R2).
	Check input bias compensator circuitry components associated with Q1.
	Check bias servo circuitry (Q108, Q208).
	Check for leaky driver transistor. (Q109, 114, 209, 214).
High bias on positive output transistors.	Check for leaky output transistor in negative bank (Q115-118, Q215-218).
High bias on negative output transistors.	Check for leaky output transistor in positive bank (Q110-113, Q210-213).

5.7.4 CHECKOUT PROCEDURE — 1KHz INPUT, NO LOAD

Connect a signal generator set at 1KHz to the amplifier input. Turn up the level control(s) and monitor the output with an oscilloscope. The waveform should appear undistorted at all amplitudes until it clips. Clipping should be sharp, with no ringing or other oscillation. If these conditions are not met, check the following:

SYMPTOM	PROBABLE CAUSE AND REMEDY
Fuse blows or + or - 60V appears at output	Output transistors shorted. (Q110-113, Q115-118, Q210-213, Q215-218). Replace. or Driver transistor(s) shorted. (Q109, 114, Q209, 214). Replace. or Pre-driver transistor(s) shorted. (Q106, 107, 206, 207). Replace. or Flyback diodes shorted. (D109, 110, 209, 210). Replace. **NOTES:** 1. Usually a component in both + and - output circuitry must short to blow the fuse with no load. 2. Usually, if only one output, driver, pre-driver or diode shorts with no load, the opposite polarity protection will activate, blocking excess current and leaving the amplifier with a + or - 60V at the output. 3. Check for open emitter resistor associated with a shorted output transistor. 4. **Replacement of output transistors.** Replacement transistors should be of the same make and general code as those removed. The code is a number stamped on the transistor, and paralleled transistors should be within adjacent number groups (i.e., 2-3, 1-2, 3-4, etc.) Coding is done at CROWN and insures that paralleled outputs will share the load equally by keeping the V_{be} values closely matched. Be sure to include all insulating material from the original transistors on the replacement. Be sure new transistors are adequately heat-sinked by using a good heat-conducting compound (Dow-Corning 340) on the transistor case where it fits against the heat sink. Tighten all mounting screws evenly.

SYMPTOM	PROBABLE CAUSE AND REMEDY
Continuous DC voltage at output	Shorted transistors or diodes in output circuitry. Check and replace as necessary. If offset is positive check the + side; if offset is negative check the - side. Defective bias servo transistor (Q108, 208). Replace. **NOTE:** As a general procedure use a voltmeter to compare voltage readings with those shown on the schematic. Begin at the input, move stage by stage through the circuitry, and note any large deviations from the quiescent voltage levels shown. Determine whether specific components are defective or simply responding to a problem elsewhere.
Oscillation at output with or without signal.	Check components on DCA main board by alternately heating and cooling (use small solder iron and circuit cooler spray) while observing the oscillation on the oscilloscope. Concentrate on transistors and diodes. Significant changes in the oscillation may pinpoint a defective component. Check diodes and resistors by paralleling with a capacitor. This may help isolate the source of an unwanted oscillation. **CAUTION:** In some cases this technique may cause oscillation so use with care. Check capacitors by paralleling them with a known good capacitor of the same value. If oscillation is eliminated, an open capacitor may be indicated.
Output unstable when adjusting level pot.	Dirty internal contacts on level pot. Temporary correction of this problem may sometimes be had by turning the pot back and forth repeatedly to allow the contacts to clean themselves. If this is unsuccessful, replace the pot.

5.7.5 CHECKOUT PROCEDURE — 1KHz INPUT, WITH LOAD

Most of the common service problems should have manifested themselves previously and the remaining test procedures should be fairly routine. If troubles do occur, a likely source is the output stages, since this is the first test where these stages are subjected to a load.

1. Connect an 8-ohm load to the output. (Refer to paragraph 5.6.2).
2. Monitor the output with an oscilloscope and an accurate AC voltmeter.
3. Connect a sine wave oscillator set at 1KHz (+10 dB out) to the amplifier input.
4. Turn up the level control of the channel under test. The output must clip at over 150 watts. Typically, the clip point is 190 watts (39 volts) or above, with the AC line voltage at 120 volts. The waveform should be clean, and should clip evenly and symmetrically with no ringing.
5. Change load to 4-ohms. Clip point should occur at approximately 350 watts.

5.7.6 CHECKOUT PROCEDURE — PROTECTION CIRCUIT TESTS

The protection circuit procedures are divided into two tests; a clipping test designed to verify the operation of the limiting circuits, and a memory test designed to check the operation of the protection memory capacitors.

a. Clipping Test

1. Set the amplifier output at approximately 35V.
2. Switch the load to 2 ohms. At this load impedance, the power out is $(35V)^2/2$ ohms = 600W. This output will cause enough power supply sag to clip the output, but may not cause the sharp clip indicative of protective circuit operation. Slowing the oscilloscope trace to look for power supply ripple at the clip level will indicate whether the power supply or protection circuits are causing the clip.

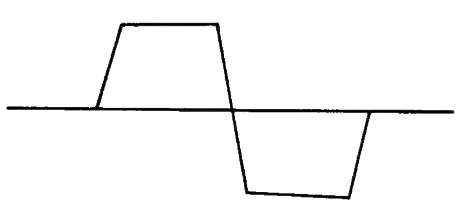


FIGURE 5-2
TYPICAL PROTECTION CLIPPING, 2-OHM LOAD

3. In order to insure that the protection circuits are operating, it may be necessary to drive a 1-ohm load. If the oscilloscope trace still shows only power supply clipping, the associated limiter(s) is not turning on and the protection circuitry is defective.

SYMPTOM	PROBABLE CAUSE AND REMEDY
+ signal does not clip on 2-ohm load.	Check components in + limiter (Q102, Q202) circuit.
- signal does not clip on 2-ohm load.	Check components in - limiter (Q103, Q203) circuit.
Either + or - signal clips at wrong level on 2-ohm load.	Check limiter circuits. Refer to Figure 5-2 for clipping levels.

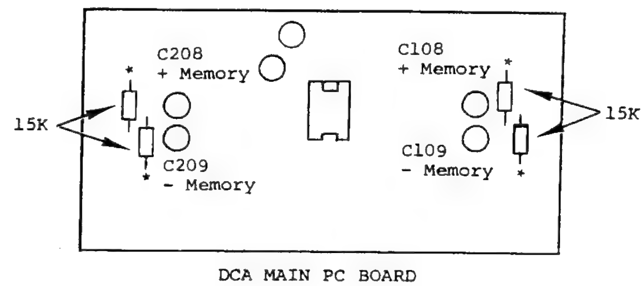


FIGURE 5-3
PROTECTION CIRCUIT COMPONENTS AND TEST POINTS

b. Protection Memory Test

Positive and negative memory capacitors are used in each channel to adjust the sensitivity and activation of the protection circuit. The operating point of the protection circuitry depends on the previous signal history fed back to the memory capacitors. Their operation is verified by monitoring the voltages developed across them for various conditions of output operation. Refer to Figure 5-3. The memory capacitors are vertically mounted white components mounted in pairs near each end of the DCA main pc board.

1. Connect a signal generator set at 1KHz to the amplifier input.
2. Connect an 8-ohm load to the amplifier output.
3. Make voltage measurement across the memory capacitor by placing the voltmeter reference leads between the output of the channel under test and the leads of the 15K resistors adjacent to the memory capacitors. Test point locations are shown in Figure 5-3 as *.
4. Check both positive and negative capacitors for the voltages shown below. Also make measurements at the same point for a 4-ohm and 2-ohm load.

TEST POINT	LOAD	VOLTAGE (Approx.)
+ Memory Capacitors (C108, C208)	8 Ohm	- .8V (± .1V)
	4 Ohm	- .7V (± .1V)
	2 Ohm	- .2V (± .1V)
- Memory Capacitors (C109, C209)	8 Ohm	+ .8V (± .1V)
	4 Ohm	+ .7V (± .1V)
	2 Ohm	+ .2V (± .1V)

Note: Measurements taken with output as zero (0) reference.

5. If voltages are within the ranges indicated, memory capacitors and associated protection memory circuitry are operating properly. Large variations (such as wrong polarity) from the given values indicate either damaged components or improper connection of the circuitry.

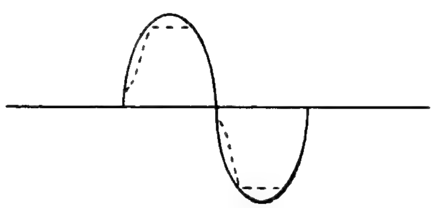


FIGURE 5-4
TYPICAL 20KHz SINE WAVE TEST OUTPUT WAVEFORM

5.7.7 CHECKOUT PROCEDURE — 20KHz SINE WAVE INPUT

1. Set the signal generator at 20KHz at the amplifier input.
2. Connect an 8-ohm load to the amplifier output.
3. Turn the level control up until clipping occurs. Clipping must take place above 150 watts (typically in the 180-190 watt range). Refer to Figure 5-4 for output waveform characteristics.

NOTE:
The output must clip before it distorts elsewhere. The dotted line in Figure 5-4 shows typical unacceptable distortion on the leading edges of the waveform.

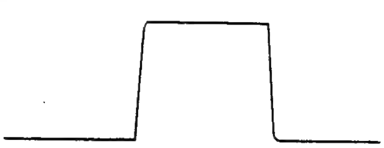


FIGURE 5-5
TYPICAL 10KHz SQUARE WAVE TEST OUTPUT WAVEFORM

5.7.8 CHECKOUT PROCEDURE — 10KHz SQUARE WAVE INPUT

This test is designed to critically examine the frequency response and rise time of the amplifier to show how fast the amplifier can follow rapid signal changes.

1. Set the signal generator for a 10KHz square wave 20V p-p at the amplifier input.
2. Connect an 8-ohm load to the amplifier output.
3. Turn up the level control to maximum.
4. The output waveform (Refer to Figure 5-5) should be clean and sharp throughout the entire range of the level control.

5.7.9 IM (INTER-MODULATION) DISTORTION TEST

1. Use the IM distortion test setup shown in Figure 5-1.
2. Calibrate the IMA and set up the IM input signal at 60 - 7KHz, 4:1 ratio as described in the IM manual.
3. Connect an 8-ohm load to the amplifier output.
4. Measure the IM distortion at 5 dB intervals from 150 watts output to 15 mv as shown below. All distortion readings must be less than 0.1%.

CHANNEL 1 and 2

.0 %	150W out	.0 %	475MW out
.0 %	47.W out	.0 %	150MW out
.0 %	15W out	.0 %	47.5MW out
.0 %	4.75W out	.0 %	15MW out
.0 %	1.5W out		

SYMPTOM	PROBABLE CAUSE AND REMEDY
High IM distortion	Deteriorating components or wire dress. Likely culprits appear below: Dress yellow-white wires down against heatsink circuit boards. Change lead dress of brown output wire between heatsink board and DCA main board. Shorten lead lengths on C17. Change C7 to 5 pf. Change positive pre-driver. Change last voltage amplifier.

5.7.10 CHECKOUT PROCEDURE — 20-20KHz HUM AND NOISE TEST

1. Use the noise test setup shown in Figure 5-1.
2. Remove inputs from the amplifier.
3. Set level controls at minimum (CCW).
4. Set AC voltmeter to 100 microvolt scale.
5. Measure the noise level relative to 150 watts (+33 dBV). The hum and noise level must be 110 dB or greater below the full 150 watt output power. A typical value is -115 to 120 dB.

SYMPTOM	PROBABLE CAUSE AND REMEDY
High noise level	Bad solder joints. Visually inspect the defective channel. Poor ground connections. Check all ground wires. Check output jack ground. Check insulating washers on input jacks.

5.7.11 CHECKOUT PROCEDURE — QUIESCENT AC POWER CONSUMPTION

Use a wattmeter and check the power consumption at the amplifier output when the amplifier is turned on (idling) but carrying no signal. The amplifier must draw **less** than 40 watts with the AC line at 120 volts. A typical reading is 30 watts.

5.8 BIAS LEVEL CHECK AND ADJUSTMENT

Refer to Figure 5-6. The correct bias level for the DC-300A amplifier is set at the factory and will not usually require adjustment unless components affecting the level are replaced. Component changes likely to affect bias settings are the pre-driver, driver, output stages and bias transistors.

Correct bias maintains the driver and pre-driver stages at normal operating levels and keeps the output stages turned off. This condition is achieved when a voltage of 325 ± 15 mv (0.325 ± .015 volts) appears across the output stage bias resistors (Channel 1, R132, R139; Channel 2, R232, R239).

a. To check bias level:

1. Remove front panel (par. 5.4.1) from amplifier.
2. This check is to be made with the amplifier idling (no input and no load).
3. Connect power to amplifier and allow unit to warm up to normal operating temperature.

CAUTION!!

Do not measure bias level voltage until unit is thoroughly warmed up. Voltage begins to climb at turn-on, peaks and gradually drops to the normal level. Measurements taken during warm-up are likely to be misleading.

4. Measure the voltage across one of the output stage bias resistors for each channel. Voltage should be between 310-345 mv. If voltage is abnormal, use the following procedure to obtain correct bias level voltage.

b. To adjust bias level voltage:

Adjustment of bias level voltage is made by changing the value of the selected resistor in the bias circuit (Channel 1, R129; Channel 2, R229). These resistors are mounted in plug-in sockets on the DCA main PC board. An auxiliary pair of sockets, adjacent to each selected resistor, is used if necessary to trim the bias level voltage to fall within the specified limits (310-345 mv). Generally, selected bias resistors range from 33 to several hundred ohms. Carbon resistors, 10% tolerance, are normally used.

1. If the measured bias voltage was **high**, replace the factory-installed resistor with one of **higher** value. This will **lower** the bias voltage.
2. If the measured bias voltage was **low**, replace the factory-installed resistor with one of **lower** value. This will **raise** the bias voltage.

Continue replacing the selected resistor, using the above procedure, to bring the bias voltage as close to 325 mv as possible.

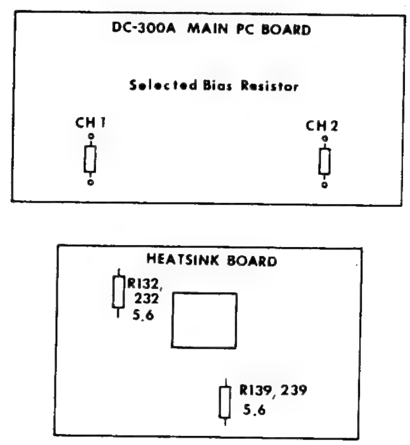


FIGURE 5-6
BIAS LEVEL COMPONENTS

5.9 INPUT/OUTPUT OFFSET ADJUSTMENT

Refer to Figure 6-4. These controls (Channel 1, R103, R105; Channel 2, R203, R205) are located on the DCA Main PC Board and are sometimes referred to as DC balance controls. They are factory-adjusted and seldom, if ever, require adjustment. Only in the most critical applications (not "hi-fi" or similar configurations) will adjustment be needed. Should adjustment be necessary, use the following procedure:

1. Remove front panel from amplifier (par. 5.4.1).
2. Apply power to amplifier and allow at least 15 minutes for thorough warm-up.
3. Set CHANNEL 1 level control (front panel) fully CCW.
4. Remove input signal from CHANNEL 1 on amplifier rear panel.
5. Place a sensitive DC voltmeter across CHANNEL 1 OUTPUT on amplifier rear panel.
6. Adjust OUTPUT OFFSET, R105, with a small, flat-bladed screwdriver, to obtain a 0 (zero) reading on the DC voltmeter.
7. Set CHANNEL 1 level control (front panel) CW to 12 o'clock.
8. Adjust INPUT OFFSET, R103, with a small, flat-bladed screwdriver, to obtain a 0 (zero) reading on the DC voltmeter.
9. Repeat steps 3 through 8 above for CHANNEL 2.

5.10 PARTS REPLACEMENT KIT

A parts replacement kit designed to supply parts for 5 to 10 repair jobs is available from CROWN as described below:

DC-300A PARTS REPLACEMENT KIT

(Designed to supply parts needed for 5-10 repair jobs.)

PARTS DESCRIPTION	CPN	QTY
Transistor:	3773	
2N3773 #2		8
2N3773 #3		6
2N3773 #4		2
Transistor:		
RCA 61061	3348	3
SS7304	2923	3
2N3859A Special NPN	2961	8
2N5383 Special PNP	2982	10
2N6175	3501	3
MPSA93	3578	2
2N4125	3625	2

PARTS DESCRIPTION	CPN	QTY
Spare Hardware for Output Transistors: Screws:		
6/32 x 3/4" binding head Phillips	2135	10
6/32 x 1/4" binding head	1954CAD	16
8 x 5/8" hex head screw	2757	8
Nuts:		
6/32 hex nuts	1889	10
Lock Washers: #6	1823	10
Diodes:		
1N270	3447	3
1N4003	2851	4
10V Zener	3549	2
Capacitors:		
10 mf/150V Cap C4	2796	2
10 mf/50V (vert.)	3728	3
.1 mf	2938	2
5 mfd - 70 vdc	1678	2
25/15 NP cap	3186	4
Potentiometers:		
100K Linear Cermet	3641	2
Resistors:		
.33 ohm	3583	9
1 ohm	3612	2
10k film	2343	4
2.7 ohm	2857	2
Input-Output Jacks:		
112A Hi-D Jax	3423	2
Dual Binding Post	2823	2
3AB 10A fuse	2819	5
Component Lead Receptacle	3519	4
Integrated Circuits:		
uA739	3231	2
Socket, 14 pin I.C.	3450	2

SECTION 6

SCHEMATICS, PARTS LISTS AND COMPONENT LOCATION

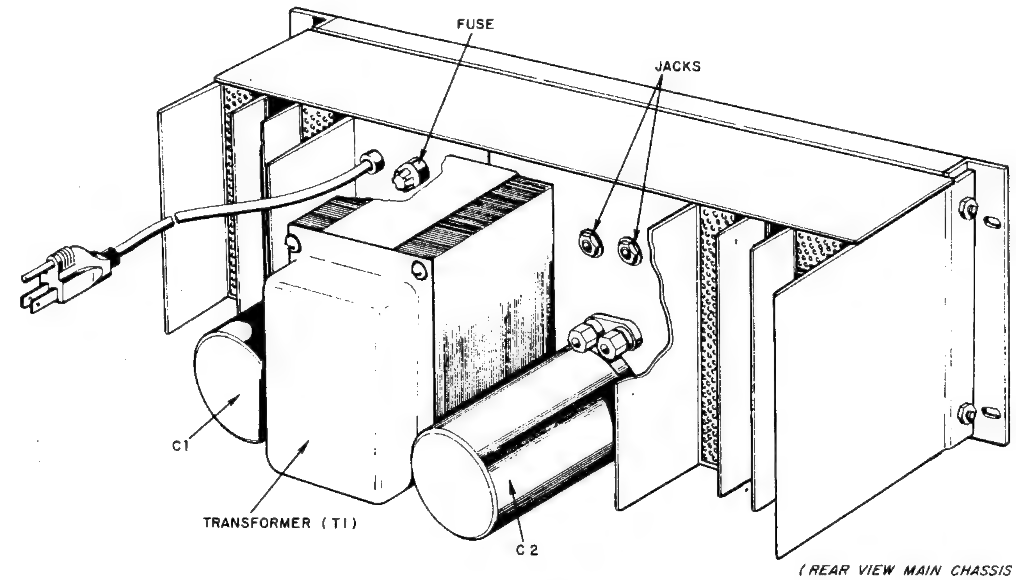
6.1 GENERAL INFORMATION

This section contains schematics, parts lists and exploded view drawings for the DC-300A Laboratory Power Amplifier. Used in conjunction with the service instructions in Section 5, this information will aid the service technician to rapidly and accurately identify and replace defective parts and return the amplifier to a normal operating condition.

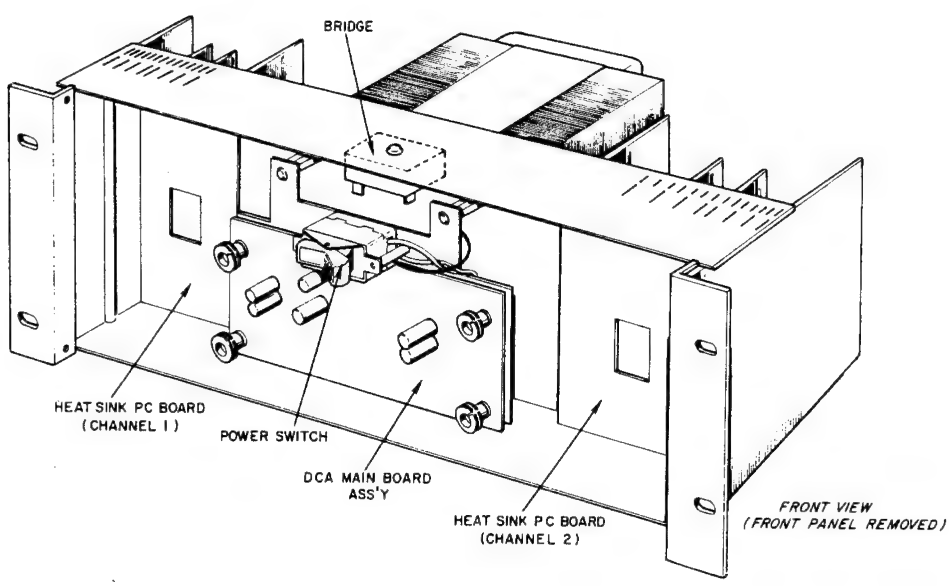
6.2 PARTS REPLACEMENT

Many amplifier parts are standard items stocked by local electronics supply houses. However, some parts which appear to be standard are actually different. Best results will be obtained with CROWN factory replacement parts, although standard parts may be used in an emergency. A number of the amplifier parts are special and are available only from CROWN.

When ordering parts, be sure to give the amplifier model and serial number as well as the part number and description of the parts ordered.

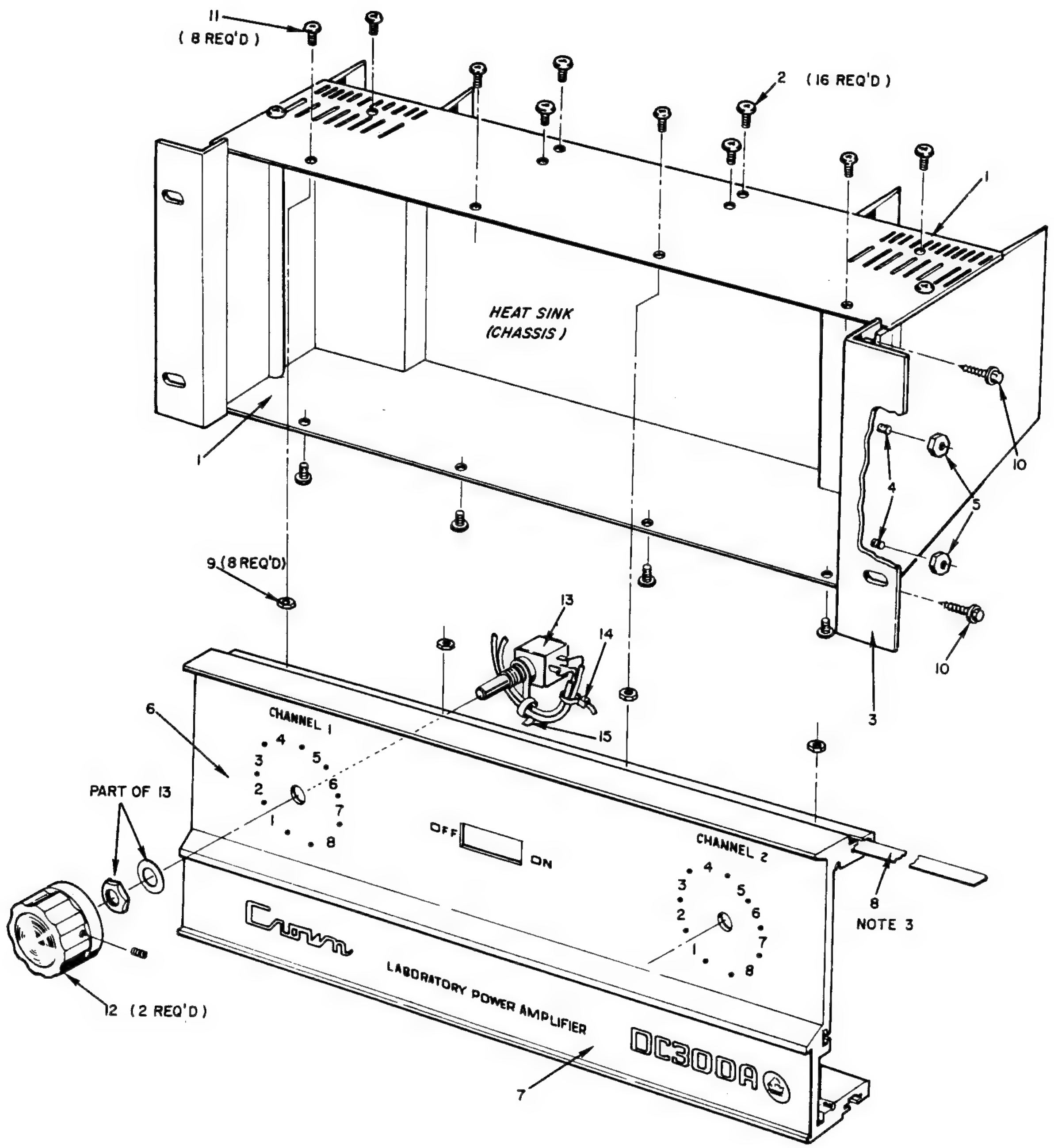


(REAR VIEW: MAIN CHASSIS)



(FRONT VIEW: FRONT PANEL REMOVED)

FIGURE 6-2
PARTS LOCATION, MAJOR ASSEMBLIES AND COMPONENTS



EXPLODED VIEW
FRONT PANEL ASSEMBLY

PARTS LIST: FRONT PANEL ASSEMBLY

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
	FRONT PANEL ASSY.			
	DCA Chassis Cover	3579	1	Mounts on side opposite chassis cover assy.
	Screw, self-tap, 10-24 x 3/8	3633	2	Used to fasten 3579
	Bracket, angle, mounting	3610	3	Mounted on sides of heatsink
	Stud, captive, 10-32 x 5/16	3635	4	Used to fasten 3610 to side
	Nut, hex, 10-32	2170	5	Used to fasten 3610 to side
	DC-300A extrusion	3572	6	Front panel
	DC-300A overlay	3608	7	Inlay on front panel
	Carrier strip	3638	8	Holds 6-32 nuts in top & bottom of front panel
	Nuts, hex, 6-32 CAD	1889	9	Mounted in carrier strips on top & bottom of front panel
	Screws, hex, sheet metal, #8 x 5/8"	2757	10	Fastens into side of front panel
	Screws, binding, 6-32 x 1/4 CAD	~~1954~~ A10086-10604	11	Fastens top and bottom of front panel
	Knob, broadcaster, #1	1577	12	Mount on level controls
R100, 200 Level Controls	Resistor, 100K ohm, linear pot	3641	13	Mount on front panel
	Cable Ties	1811	14	Used to dress leads from input pots
	Solder lug, .375 hole	2828	15	Mount next to front panel under level control

FRONT PANEL ASSEMBLY

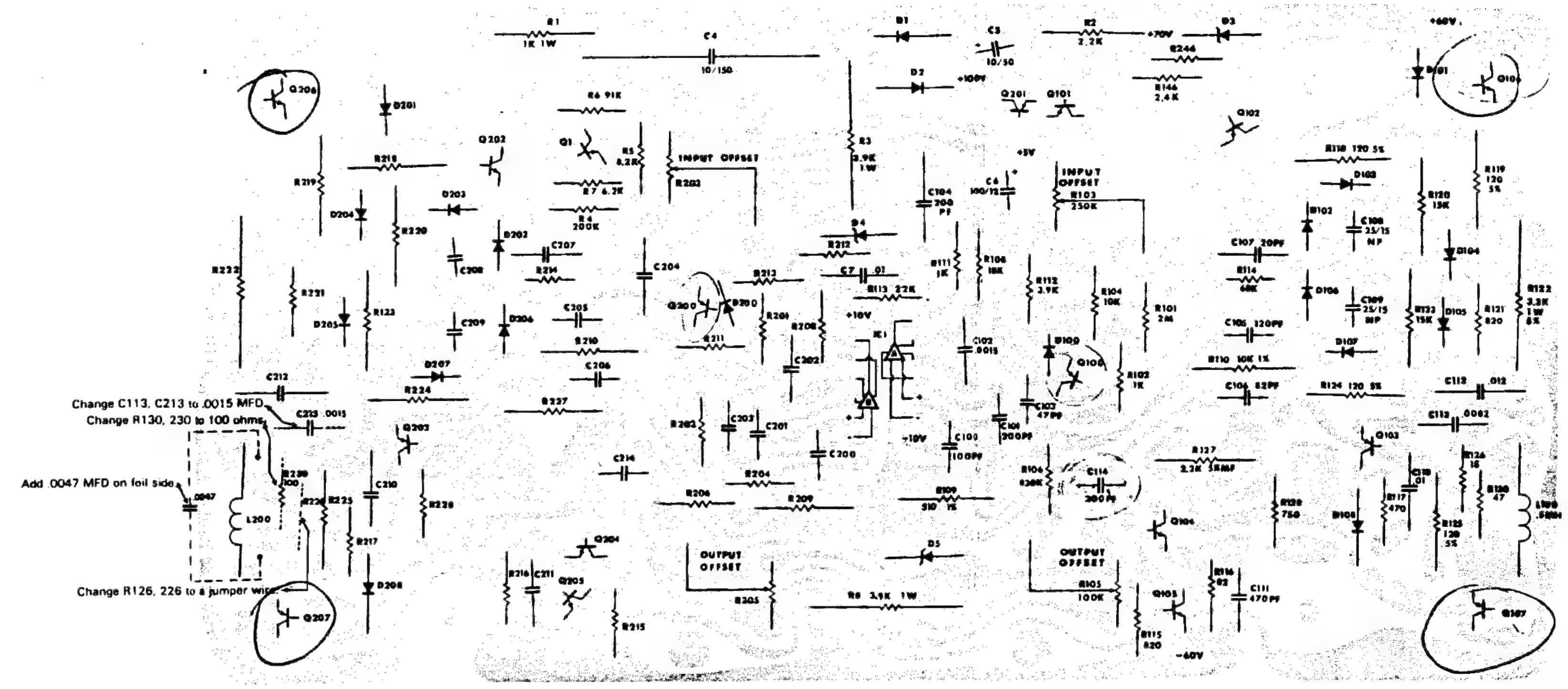
NOTES:

1. Main heatsink not part of Front Panel Assembly.
2. Four identical screws on bottom of Front Panel (not shown).
3. Carrier strip, with four hex nuts, slides into slots along top and bottom edges of Front Panel extrusion.
4. Cable ties and solder lug shown in detail of level control pots.

FIGURE 6-3
PARTS LOCATION, FRONT PANEL ASSEMBLY

PARTS LIST: DCA MAIN BOARD ASSEMBLY

Schematic Designation	Description	Crown Part No.	Other Information
	DC-300A MAIN BOARD ASSEMBLY	41188MT	Complete, except wires.
	DCA Main PC Board	7958U	Holes drilled
	Capacitors:		
C4	10 mfd, 150V	2796	
C5	10 mfd, 50V, vertical	3728	
C6	100 mfd, 16V, vertical	3729	
C7, 110, 210	.01 mfd, disc, ceramic	1751	
C100, 200	100 pf, mica	3410	
C101, 104, 114, 201, 204, 214	200 pf, mica	3411	
C102, 202	.0015 mfd, 200V, filmatic	3089	
C103, 203	47 pf, mica	3409	
C105, 205	120 pf, mica	3290	
C106, 206	82 pf, mica	3627	
C107, 207	20 pf, ceramic	3535	
C108, 109, 208, 209	25 mfd, 15V NP vertical	3186	
C111, 211	470 pf, mica	2511	
C112, 212	.012 mfd, 200V filmatic	3219	
C113, 213	.0082 mfd, 200V, filmatic	3063	
C119, 219	200 pf, mica	3411	Used only if oscillation occurs during test.
	Coils:		
L100, 200	.5 mhy axial lead (green)	3510	
	Diodes:		
D1, 2	IN4003	2851	
D3, 4, 5	IN961B, 10V, Zener	3549	
D100-107, 200-207	IN4148	3181	
D108, 208	IN270	3447	
	Integrated Circuit:		
1CIA, 1B	u A739 or	3231	
	u A749	3643	May be substituted with proper load resistor. (See R107, 207)
	Resistors:		
R1	1K ohm, 1W, 10%	3615	
R2	2.2K ohm, .5W, 10%	1036	
R3, 8	3.9K ohm, 1W, 10%	3618	
R4	200K ohm, .25W, 5%	3622	
R5	8.2K ohm, .25W, 10%	2877	
R6	91K ohm, .25W, 5%	3621	
R7	6.2K ohm, .25W, 5%	3619	
R9	2.7 ohm, .5W, 10%	2857	Wired between main board and terminal strip on main shield.
R101, 201	2 megohm, .25W, 5%	3199	
R102, 111, 202, 211	1K ohm, .25W, 10%	2627	
R103, 203	250K ohm, horizontal pot	3087	Input Offset Pot
R104, 204	10K ohm, .25W, 10%	2631	
R105, 205	100K ohm, horizontal pot	1709	Output Offset Pot
R106, 206	820K ohm, .25W, 10%	3623	
R107, 207	3.3K ohm, .25W, 10%	2629	Used when IC is uA749
	or		
R107, 207	10K ohm, .25W, 10%	2631	Used when IC is uA739
R108, 208	18K ohm, .25W, 10%	2633	
R109, 209	510 ohm, .5W, 1%, film	3304	
R110, 210	10K ohm, .5W, 1% film	2343	
R112, 212	3.9K ohm, .25W, 10%	2630	
R113, 213	22K ohm, .25W, 10%	3302	
R114, 214	68K ohm, .25W, 10%	3620	
R115, 121, 215, 221	820 ohm, .25W, 10%	3301	



Schematic Designation	Description	Crown Part No.	Other Information
	Resistors (Continued)		
R116, 216	82 ohm, .25W, 10%	3300	
R117, 217	470 ohm, .25W, 10%	2626	
R118, 119, 124, 125, 218, 219, 224, 225	120 ohm, .5W, 5%	3837	
R120, 123, 220, 223	15K ohm, .5W, 10%	1064	
R122, 222	3.3K ohm, 1W, 5%	3617	
R126, 226	15 ohm, .25W, 10%	3614	
R127, 227	2.2K ohm, .5W, 5%, film	3145	
R128, 228	750 ohm, .25W, 5%	3509	
R130, 230	47 ohm, .25W, 10%	1011	
R146, 246	2.4K ohm, .25W, 5%	3616	
	Transistors:		
Q1, 102, 105, 202, 205	2N3859A (selected)	0 2961 7	
Q100, 101, 200, 201	MPS A93	C 3578 9	
Q103, 203	2N4125	3625	
Q104, 204	2N6175	3501	
Q106, 206	40327 (selected)	3348	Pos Pre-driver (RCA61061)
Q107, 207	2N4929 SS7304	0 2923 7	Neg Pre-driver
	Miscellaneous:		
	Mounting Pad, TO-5	1250	Used to mount pre-drivers (Q101, 107, 206, 207)
	Cooler, TO-5	3175	Mount on pre-drivers
	IC Socket, 14-pin	3450	
	Cooler, TO-92, dual	3493	Used on Q101, 102
	Receptacle, PC	3519	
	Heatsink clip, NR 387A	3586	Used on Q104, 204
	Screws, sheet metal, #8 x 5/8	2757	Fasten main board to shield.

LEFT CHANNEL SHOWS STANDARD VALUES.

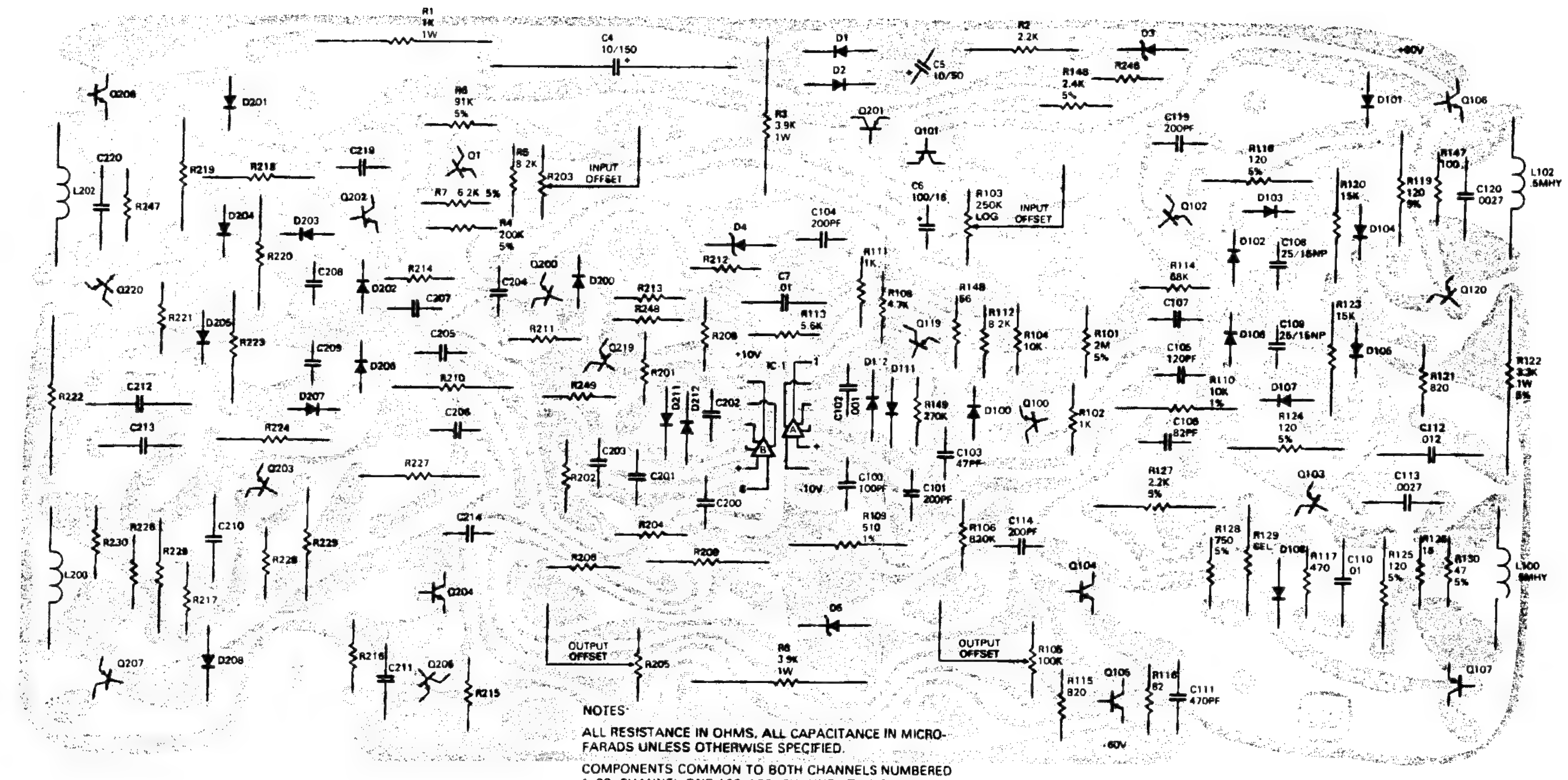
RIGHT CHANNEL SHOWS STANDARD VALUE CHANGES WHEN NPC (2N3773) OUTPUT DEVICES ARE USED. (SEE SCHEMATIC FOR FURTHER CLARIFICATION.) IN ANY GIVEN AMPLIFIER, BOTH CHANNELS WILL BE THE SAME.

÷3293

FIGURE 6-4

PARTS LIST: DCA MAIN BOARD — NON 2N3773 OUTPUTS

Schematic Designation	Description	Crown Part No.	Other Information
	DC-300A MAIN BOARD ASSEMBLY	41412	Complete, except wires.
	DCA Main PC Board	9555	Holes drilled
	Capacitors:		
C4	10 mfd, 150V	2796	
C5	10 mfd, 50V vertical	3728	
C6	100 mfd, 16V vertical	3729	
C7, 110, 210	.01 mfd, disc ceramic	1751	
C100, 200	100 PF mica	3410	
C101, 201, 104, 204, 119, 219 114, 214	200 PF mica	3411	
C102, 202	.001 disc ceramic	2288	
C103, 203	47 PF mica	3409	
C105, 205	120 PF mica	3290	
C106, 206	82 PF mica	3627	
C107, 207	20 PF ceramic	3535	When outputs are CPN3941
C107, 207	10 PF mica	2821	When outputs are CPN3937
C108, 208, 109, 209	25 mfd, 15 VNP vertical	3186	
C111, 211	470 PF mica	2511	
C112, 212	.012 mfd 200V filmatic	3219	
C113, 213, 120, 220	.0027 mfd 200V filmatic	3481	
	Coils:		
L100, 200, 102, 202	.5 mhy axial lead	3510	
	Diodes:		
D1, 2	1N4003	2851	
D3, 4, 5	1N961B 10V zener	3549	
D100-107, 200-207	1N4148	3181	
D108, 208, 111, 211, 112, 212	1N270	3447	
	Integrated Circuit:		
IC-1A, B	u A739 or	3231	R107, 207 omitted
	u A749	3643	R107, 207 is CPN2629
	Resistors:		
R1	1K ohm, 1W, 10%	3615	
R2	2.2K ohm, .5W, 10%	1036 -0	
R3, 8	3.9K ohm, 1W, 10%	3618	
R4	200K ohm, .25W, 5%	3622	
R5, R112, 212	8.2K ohm, .25W, 10%	2877	
R6	91K ohm, .25W, 5%	3621	
R7	6.2K ohm, .25W, 5%	3619	
R9	2.7 ohm, .5W, 10%	2857-8	Wired between main board and terminal strip on main shield.
R101, 201	2M ohm, .25W, 5%	3199	
R102, 202, 111, 211,	1K ohm, .25W, 10% 7 10 .10	2627-5	
R103, 203	250K ohm, horizontal pot	3087	Input offset pot
R104, 204	10K ohm, .25W, 10%	2631	
R105, 205	100K ohm, horizontal pot 5 6 H .50	1709-2	Output offset pot
R106, 206	820K ohm, .25W, 10%	3623	
R107, 207	3.3K ohm, .25W, 10%	2629	Used when IC-1 is uA749, omitted when uA739.
R108, 208	4.7K, .25W, 10%	3939	
R109, 209	510 ohm, .5W, 10% film	3304	
R110, 210	10K ohm, .5W, 1% film	2343	
R113, 213	5.6K ohm, .25W, 10%	3220	
R114, 214	68K ohm, .25W, 10%	3620	
R115, 215, 121, 221	820 ohm, .25W, 10%	3301	
R116, 216	82 ohm, .25W, 10%	3300	
R117, 217	470 ohm, .25W, 10%	2626	
R118, 218, 119, 219, 124, 224, 125, 225	120 ohm, .5W, 5%	3837	
R120, 220, 123, 223	15K ohm, .5W, 10%	1064	
R122, 222	3.3K ohm, 1W, 5%	3617	
R126, 226	15 ohm, .25W, 10%	3614	
R127, 227	2.2K ohm, .5W, 5% film	~~3145~~ C 1036-C	



NOTES:
ALL RESISTANCE IN OHMS, ALL CAPACITANCE IN MICRO-FARADS UNLESS OTHERWISE SPECIFIED.
COMPONENTS COMMON TO BOTH CHANNELS NUMBERED 1-99, CHANNEL ONE 100-199, CHANNEL TWO 200-299.
VALUES GIVEN FOR LEFT CHANNEL ONLY; RIGHT CHANNEL IDENTICAL
FOIL SIDE SHOWN
LOAD RESISTORS (FROM PINS 1 AND 13, TO -10V SUPPLY) ARE OMITTED WHEN IC-1 IS uA739, 3.3K WHEN uA749 IS USED

Schematic Designation	Description	Crown Part No.	Other Information
	Resistors (Continued)		
R128, 228	750 ohm, .25W, 5%	~~3509~~ < 3803 ->	
R130, 230	47 ohm, .25W, 10%	1011	
R146, 246	2.4K ohm, .25W, 5%	3616	
R147, 247	100 ohm, .25W, 10%	2872	
R148, 248	56 ohm, .25W, 10%	3511	
R149, 249	270K ohm, .25W, 10%	2885	
	Transistors:		
Q1, 102, 202, 105, 205	2N3859A (selected)	2961	
Q100, 200, 103, 203, 119, 219,	2N4125	3625	
Q101, 201, 120, 220	MPS A93	3578	
Q104, 204	2N6175	3501	
Q106, 206	RCA 61061 (selected)	3348 -6	Positive pre-driver
Q107, 207	2N4929 SS7304	2923-7	Negative pre-driver
	Miscellaneous:		
	Mounting Pad, TO-5	1250	Used to mount pre-drivers (Q106, 206, 107, 207)
	Coolers, TO-5	3175	Mount on pre-drivers
	IC Socket, 14-pin	3450	
	Cooler, TO-92, dual	3493	Used on Q101, 201
	Receptacle, PC	3519	
	Heatsink Clip NR387A	3586	Used on Q104, 204
	Screws, sheet metal, #8 x ⅝	2757	Fasten main board to shield

From SN A11,777 to A11,802 PC boards 7958 and 9555 were used interchangeably. After A11,802, 9555 used exclusively

Circuit 9555 (schematic MI-250A) was designed for Fairchild or RCA 1B05 type outputs. 2N3773 outputs can be used with the following modifications:

C113, 213 changed from .0027 MFD to .0082 MFD

C107, 207 is 20 PF

To improve the DC drift characteristics, this circuit has been modified as follows:

SN A11,777 through A12,110

D111, 211, 112, 212 removed

R149, 249 270K changed to 180K (CPN 2884)

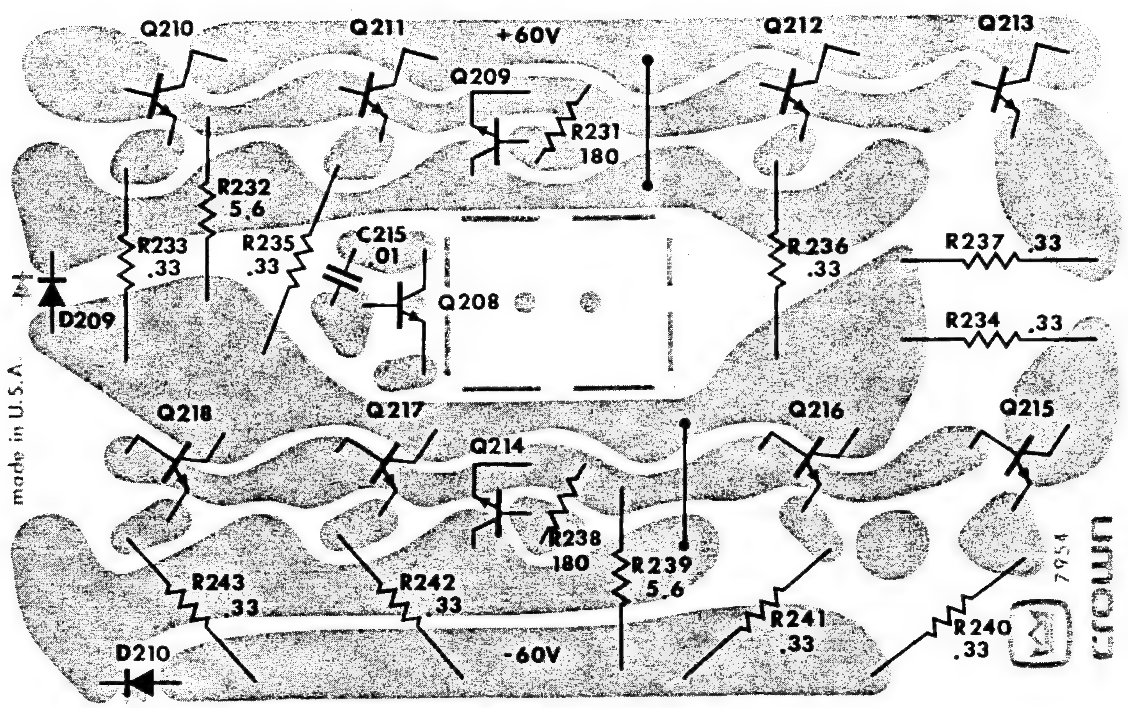
SN A12, 111 on

D112, 212 removed

D111, 211 changed to CPN 3181

R149, 249 changed to 180K (CPN 2884)

FIGURE 6-4
PARTS LOCATION DCA MAIN BOARD ASSEMBLY



Heatsink PC Board, 7954u, Component Location

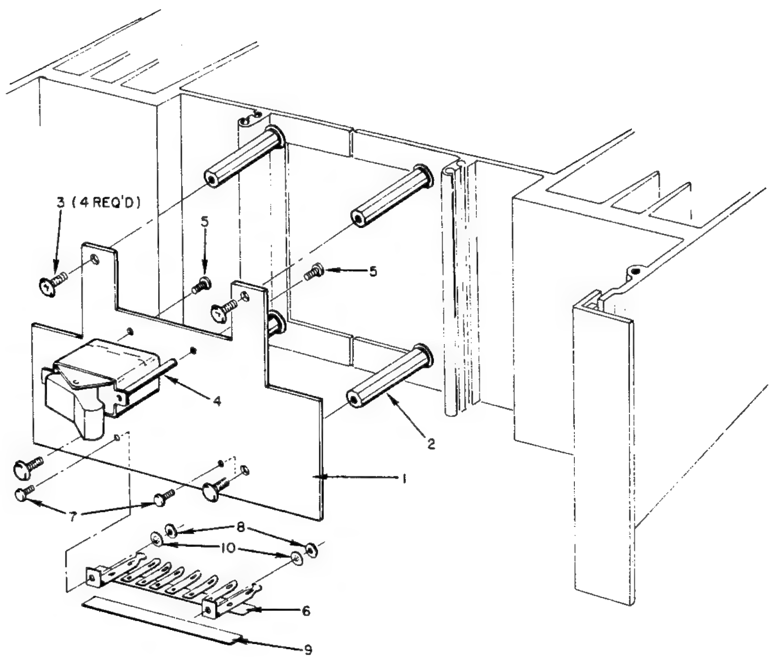
NOTE:

REFERENCE DESIGNATIONS SHOWN ON BOARD LAYOUT ARE FOR CHANNEL 2. CHANNEL 1 IS IDENTICAL: REFERENCE DESIGNATIONS PREFIXED WITH 1 (D109, etc).

PARTS LIST: HEATSINK BOARD ASSEMBLY 41207

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
	HEATSINK BOARD ASSEMBLY	41207		Includes associated parts mounted on board or heat-sink. (one channel)
	DC-300 Heatsink	3561		
	Heatsink PC Board	7954u		
	Capacitors:			
C115	.01 mfd, Ceramic disc	1751		On heatsink PC board
C117	.22 mfd, 100V, Filmatic	3218		On heatsink
	Diodes:			
D109, 110	IN4003	2851		On heatsink PC board
	Resistors:			
R131, 138	180 ohm, .25W, 10%	2873		On heatsink PC board
R132, 139	5.6 ohm, 1W, 5%	2355		On heatsink PC board
R133-137, 140-143	.33 ohm, 5W, 5%	3583		On heatsink PC board
SW-2	**Switch Thermal**, SPSNO 160F	2799		On heatsink
	Transistors:			
Q108	2N3859A (selected)	2961		Attach to heatsink with 2162 Compound.
Q109, 114	2N5804 (selected)	3626		Driver transistors.
Q110-113, 115-118	2N3773 (selected)	3773		Output transistors. (Same number for all mfgrs. Specify mfgr. with following suffixes: A=RCA B=Fairchild C=Solitron D=STC E=Sensitron F=Fair-child (90 V special) G=NPC H=TRW)
	Miscellaneous			
	Insulator, TO-3, anodized	3570		Mounts outputs & drivers
	Insulator, TO-3	3179		Mounts outputs & drivers
	Compound, Type 340, Heatsink	2162		Mounts outputs & drivers
	Lockwasher, Star, #6	1823		Mounts outputs & drivers
	Nut, Hex, 6-32, CAD	1889		Mounts outputs & drivers
	Screw, binding head, 6-32 x 3/4	2135		Mounts outputs & drivers
	Lug, solder, 505, #6 hole	3163		Used as terminals on PC board and heatsink

FIGURE 6-5
PARTS LOCATION, HEATSINK BOARD ASSEMBLY

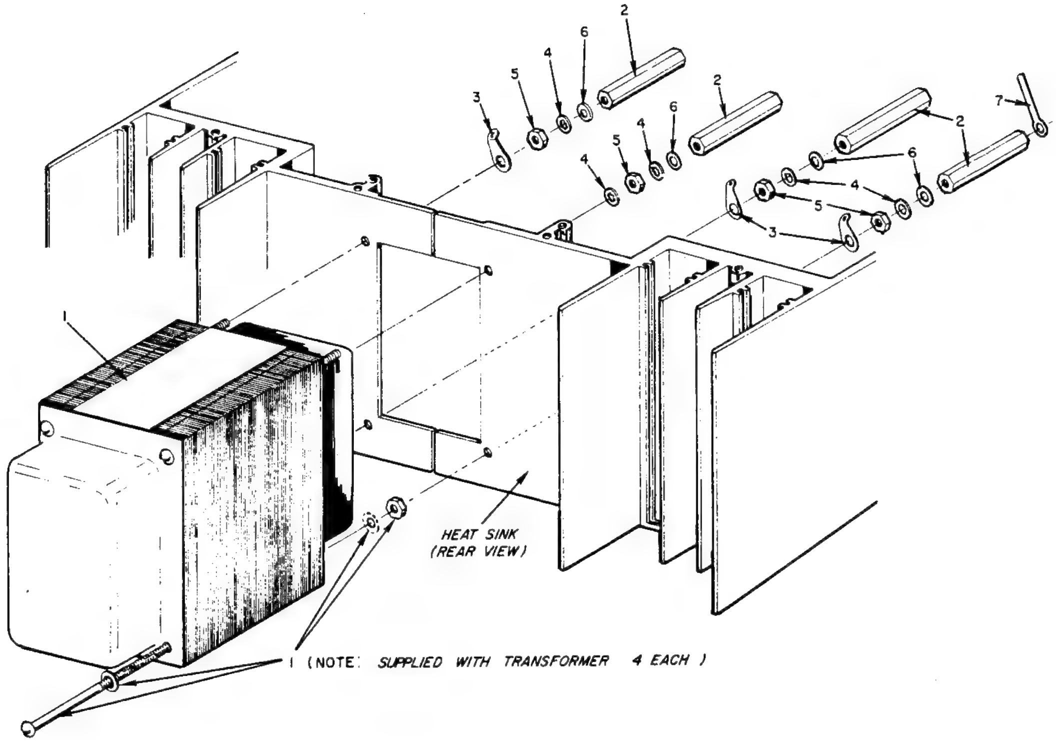


EXPLODED VIEW

PARTS LIST: SHIELD ASSEMBLY

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
	SHIELD ASSEMBLY	41202		Complete with hardware.
	Main board shield	3580	1	Mounted on spacers.
	Spacer, shield, brass	3581		Mounted on transformer screws (10-24).
	Screw, truss head, 3/32 x 3/8 CHR	2155	3	To mount shield on transformer spacers.
	Tube, brass, 7-32 x .020	3637	4	To mount power switch.
	Screw, binding head, 6-32 x 1-1/4	3634	5	To mount power switch.
	Terminal strip, #6 hole	3503	6	Mounted on shield.
	Screw, binding head, 6-32 x 3/8	2134	7	To mount terminal strip.
	Nut, Hex, 6-32, CAD	1889	8	To mount terminal strip.
Added after SN A 7114	Insulator	3600	9	Under terminal strip.
	Lockwasher, Star, #6	1823	10	To mount terminal strip.
	Nut, expansion, 1/4"	2544	11	Mounted on shield in square holes.
	Screw, Hex, sheetmetal, #8 x 5/8	2757	12	Used to secure main PC board to shield

FIGURE 6-6
PARTS LOCATION, SHIELD ASSEMBLY



EXPLODED VIEW

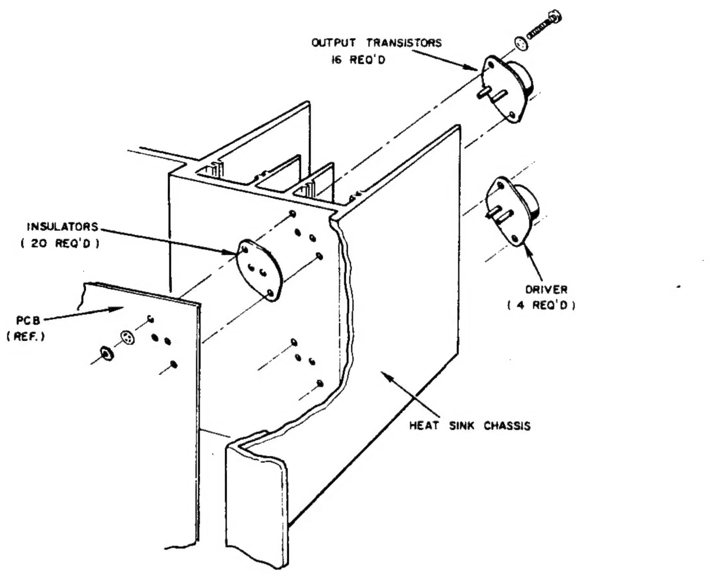
PARTS LIST: TRANSFORMER ASSEMBLY

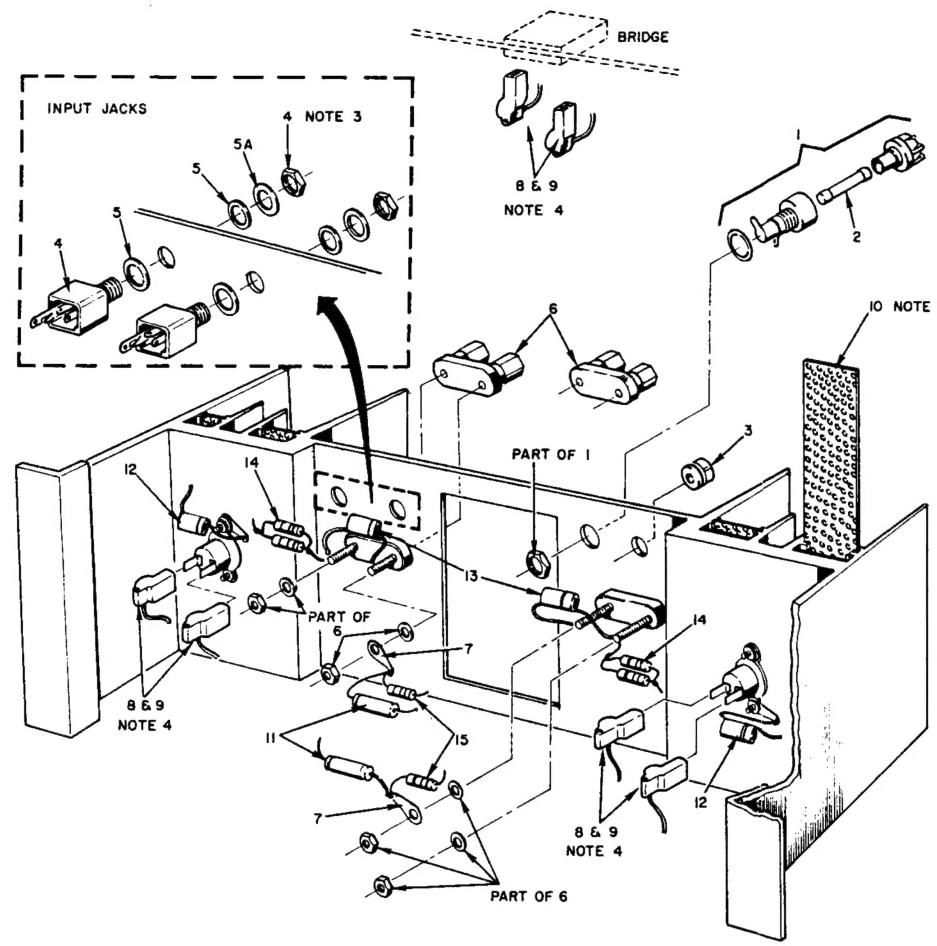
Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
	TRANSFORMER ASSY.	41204		Complete with parts and hardware.
T1	Transformer, power, 46P6A	3435	1	Supplied with mounting screws (10-24)
	Spacer, shield, brass	3581	2	Mounted on transformer screws
	Lug, solder, 806, #10 hole	3312	3	Used under 3581 spacer and 2829 nut for grd. lug (3 position only)
	Lockwasher, Star, #10	2279	4	Used over transformer screws; one in position not having 3312 lug, 4 on top of 2829 nuts.
	Nuts, Hex, #10-24	2829	5	To mount transformer
	Washer, panel, CAD	3830	6	Used between 2829 nuts and 3581 spacer.
	Lug, solder	3664	7	Used over one 3581 spacer to secure input cables.

FIGURE 6-7
PARTS LOCATION, TRANSFORMER ASSEMBLY

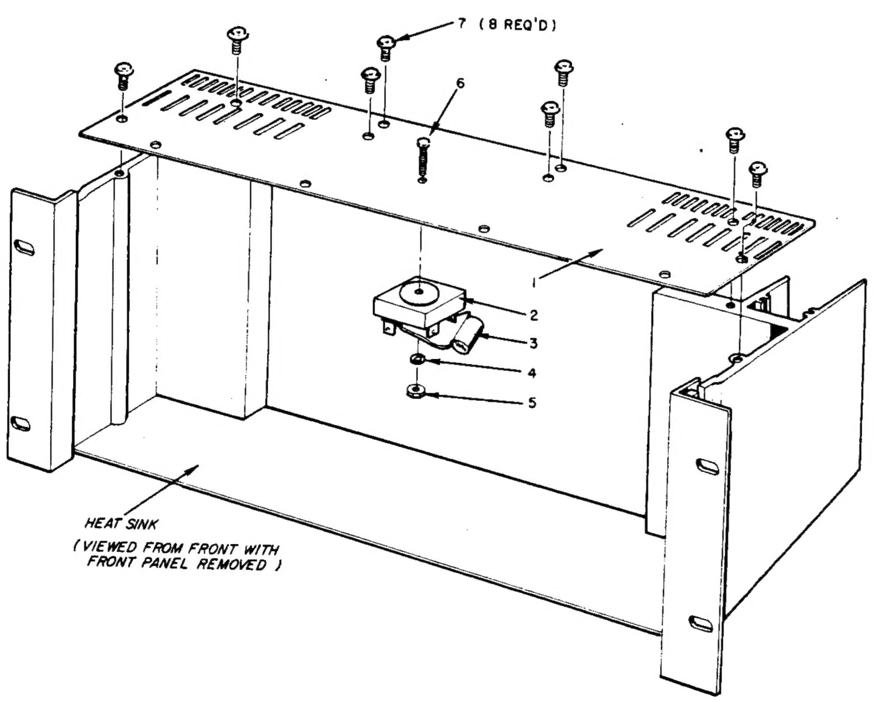
NOTES:

1. Parts shown above chassis outline are mounted on rear of panel.
2. Parts shown below chassis outline are mounted inside the unit.
3. Part of input jacks. Not shown in parts list.
4. Terminal is inside white plastic housing.
5. Four covers slide into heatsink over transistors; two on each side.





EXPLODED VIEW — CHASSIS



EXPLODED VIEW — CHASSIS COVER ASSEMBLY

PARTS LIST: CHASSIS

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
	CHASSIS			With parts mounted.
	Fuseholder, HTA	3526	1	Supplied with nut and rubber washer
F1	Fuse, 10A, 3AB	2819	2	
	Strain relief	3582	3	Used to secure power cord
	Hi-D Jax, 112A, 2-conductor	3423	4	Input jacks
	Washer, shoulder, fiber 3/8"	1306	5	Used to mount jacks
	Washer, flat, fiber	1646	5a	Used to mount jacks
	Binding post, dual	2823	6	Output connectors
	Solder lug, 505, #6 hole	3163	7	Mounted on negative terminal of 2823
	250 Faston terminal	3298	8	Used to connect wires to bridge and thermal switch
	250 Faston terminal housing	3297	9	
	Transistor covers, black, perforated	79595	10	Slide into heatsink before installing cover
	Capacitors:			
C116, 216	5 mfd, 70V	1678	11	Mounted on dual binding post 2823
C117, 217	.22 mfd, 100V, filmatic	3218	12	Mounted on thermal switch
C118, 218	.1 mfd, 200V, filmatic	2938	13	Mounted on dual binding post 2823
	Resistors:			
R144, 244	5.6 ohm, 1W, 5% or	2355	14	Two in parallel per channel from dual binding post to heatsink board, or use 3613
R144, 244	2.7 ohm, 2W, 5%	3613	14	
R145, 245	1 ohm, .5W, 5%	3612	15	Mounted on dual binding posts

PARTS LIST: CHASSIS COVER ASSEMBLY

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
	CHASSIS COVER ASSEMBLY	41209		Includes parts and hardware
	Cover, chassis	3579	1	
DMI	Bridge, SDA9903	3526	2	On chassis cover
C3	Capacitor, .1 mfd, 200V filmatic	2938	3	On bridge assembly
	Compound, Type 340 Heatsink	2162		Use to mount bridge
	Lockwasher, Star, #6	1823	4	Use to mount bridge
	Nut, Hex, 6-32, CAD	1889	5	Use to mount bridge
	Screw, binding head, 6-32 x 1/2 CAD	2176	6	Use to mount bridge
	Screw, self-tap, 10-24 x 2/8	3633	7	Use to mount cover to heatsink (chassis)

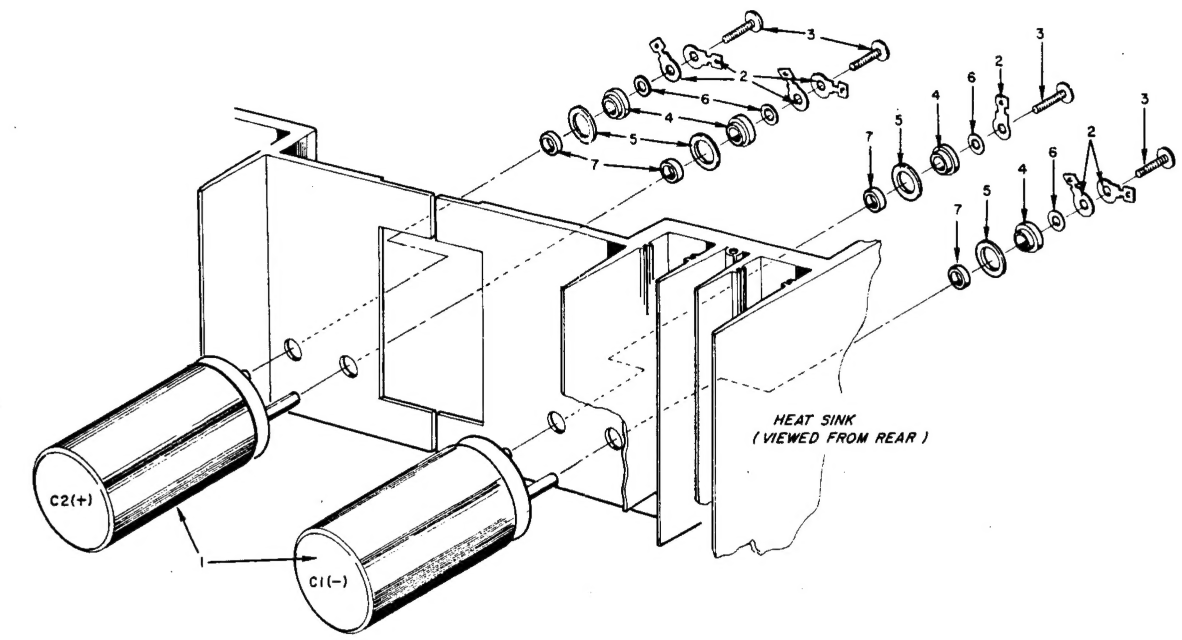
FIGURE 6-8
PARTS LOCATION, CHASSIS AND CHASSIS COVER ASSEMBLY

PARTS LIST: POWER CORD ASSEMBLY

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
	POWER CORD ASSY.	41200		Leads cut and tinned
	Power cord 3 #18 male	3474		

PARTS LIST: POWER SW ASSEMBLY

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
SW-1	**POWER SWITCH ASSY, Switch & Terminal**	3584		Faston terminal attached to one wire
	250 Faston Terminal	3297		Terminal housing

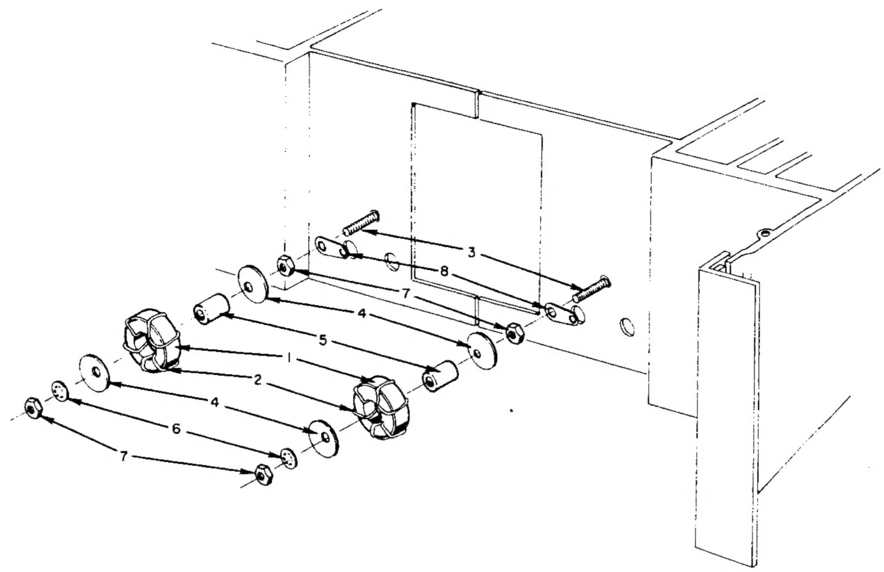


EXPLODED VIEW — FILTER CAPACITOR ASSEMBLY

PARTS LIST: FILTER CAPACITOR ASSEMBLY

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
	FILTER CAPACITOR ASSEMBLY	41268		Includes parts and hardware
C1, C2	Capacitor, 13, 500 mfd, 70V	3436	1	Mounted on heatsink
	Lug, solder, .218 hole	2934	2	Positive capacitor uses 2 on each terminal; on top of 3320
	Screw, trusshead, 10-32 x ½, NIC	2049	3	Used to mount capacitor
	Washer, shoulder, fiber	3320	4	Mounted inside 1309 to insulate screw
	Washer, nylon	1309	5	Mounts over capacitor terminals
	Washer, metal, flat, .473 OD	3830	6	Mounts between 3320 and 2934

FIGURE 6-9
PARTS LOCATION, FILTER CAPACITOR ASSY., POWER SWITCH ASSY., AND POWER CORD ASSY.



EXPLODED VIEW

PARTS LIST: OUTPUT COIL ASSEMBLY

Schematic Designation	Description	Crown Part No.	Draw No.	Other Information
L101	**OUTPUT COIL ASSEMBLY**	41206		
	Toroid form	2850	1	
	Magnet wire, #14 (13" lg)	3630	2	Wound on form 2850
	Stud, captive, #10 x 1-1/4	3636	3	Used to mount coil assy.
	Spacer, nylon	3609	4	One used on each side of coil
	Spacer, nylon	2762	5	Used in center of coil; over stud 3636
	Lockwasher, Star, #10	2279	6	To mount coil
	Nut, Hex, 10-32	2170	7	To mount coil
	Lug, solder, 806, #10	3312	8	Mounted under nut; under coil

NOTE:
Large filter capacitor (C1 or C2) adjacent to output coil assembly must be removed to remove stud from chassis.

FIGURE 6-10
PARTS LOCATION, OUTPUT COIL ASSEMBLY

APPLICATION NOTES

GENERAL

Application notes will be published periodically and distributed to owners of CROWN equipment for insertion in the service manual.

Information will be distributed concerning component changes, new accessories, special applications, modifications to equipment and any other technical data CROWN considers significant to help you use and maintain our equipment in optimum operating condition.